C. 1
APR
97

GUARDIAN I,
GUARDIAN II,
GUARDIAN III,
GUARDIAN IV,

GUARDIAN 100,
GUARDIAN 200,
GUARDIAN 300
&

GUARDIAN 400

Guardian
AC/DC Dielectric Analyzer
Instruction Manual

Form 150113/C1

QuadTech

Formerly GenRad Instruments

C. 1
APR
97

Guardian
AC/DC Dielectric Analyzer
Instruction Manual

Form 150113/C1

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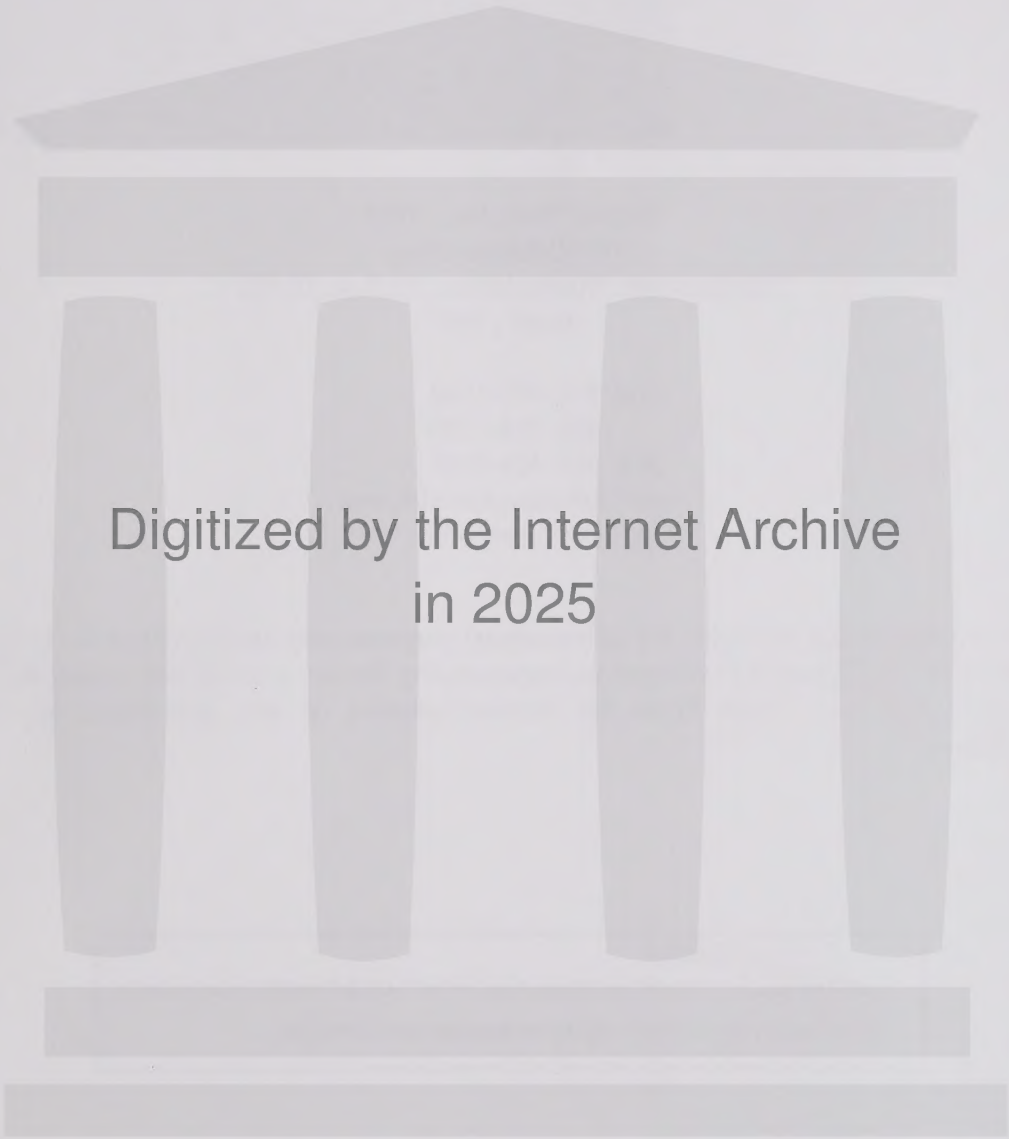

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Warranty

QuadTech warrants that Products are free from defects in material and workmanship and, when properly used, will perform in accordance with QuadTech's applicable published specifications. If within one (1) year after original shipment it is found not to meet this standard, it will be repaired, or at the option of QuadTech, replaced at no charge when returned to a QuadTech service facility.

Changes in the Product not approved by QuadTech shall void this warranty.

QuadTech shall not be liable for any indirect, special or consequential damages, even if notice has been given of the possibility of such damages.

This warranty is in lieu of all other warranties, expressed or implied, including, but not limited to any implied warranty or merchantability or fitness for a particular purpose.

SERVICE POLICY

QuadTech policy is to maintain product repair capability for a period of at least five (5) years after original shipment and to make this capability available at the then prevailing schedule of charges.

Specifications

Dielectric Strength

Output Voltage: Range:
- 100V to 5KV AC, 10V/step, programmable, 60 Hz
- 100V to 6KV DC, 10V/step, programmable * (positive pole grounded)

*** Guardian 200 and 400 only**

Accuracy:
- Setting: +/-(2% + 50V)
- Reading: +/- (1.5%+ 20V)

Stability: <+/- 1% for line voltage +/-10%
DC Ripple: < 1% for I=100μA (for DC)
AC Output Z: 500 kΩ

Leakage Current: Range:
- 0 to 10mA AC, 10μA/step, programmable
- 0 to 5mA DC, 10μA/step, programmable

Accuracy: +/- (2.5% + 20μA)

Breakdown: Detection:
- Imax: 10μA to 9.99mA AC, 5mA DC
- ΔI: (arc > 10μsec +/- 20%) 1mA +/- 10%

Indication: Visual (numeric message) or audible sound
Discharge through 1.5 MΩ

Min Threshold: 10μA to 9.99mA, programmable

Test Time: Manual or Auto (rise, hold and fall, 0 to 999 sec)

Insulation Resistance (Guardian 300 and 400 only)

Measurements:

Range	Range with G07 IR ext option	Voltage*
50 kΩ to 20 GΩ	50 kΩ to 200 GΩ	50 V
100 kΩ to 40 GΩ	100 kΩ to 400 GΩ	100 V
250 kΩ to 100 GΩ	250 kΩ to 1 TΩ	250 V
500 kΩ to 200 GΩ	500 kΩ to 2 TΩ	500 V

* (positive pole grounded)

Accuracy: Measurement: +/- (1.5% + 1 count)
+/- (2% + 1 ct) w/G07 option at 50 & 100 VDC
+/- (1% +V_{test}/100 + 1 ct) w/G07 option at 250 & 500VDC
Voltage: +/- (1% + 2 V)

Ranging: Automatic

Measure Time: 0 - 999 sec, programmable in 1 sec steps

Current Limited: 2mA +/- 10% Discharge through 2.2 kΩ

Limit Detection: High and Low (LED & audible) 50 kΩ to 200 GΩ (2TΩ w/G07 option)

Specifications Continued

General

Mechanical: Bench mount with carrying handles
Dimensions: (w x h x d): 13.5x5.2x13in (339x131x324mm)
Weight: 25 lbs (12kg) net, 29 lbs (14kg) shipping

Environmental: Meets MIL-T-28800E, Type 3, Class 5, Style E & F
Operating: 0 to + 45° C
Humidity: 45% ± 5 % RH
Storage: - 10 to + 60° C

Power:
- 115 V +/- 10%
- 230 V +/- 10%
- 47 - 63 Hz
- 70 W max

Supplied:
- Instruction Manual
- Calibration Certificate
- Power Cable
- Test Probe

Ordering Information:

Description	Catalog No.
AC Hipot Tester	**Guardian 100***
AC/DC Hipot Tester	**Guardian 200***
AC Dielectric Analyzer	**Guardian 300***
AC/DC Dielectric Analyzer	**Guardian 400***
Options & Accessories:	
RS-232 Interface	G01
0/10 V Input/Output	G02
Rack Mount Kit	G03
Rear Panel Connection	G04
Probe Cable, Unterminated	G05
Custom IR Test Voltage (factory installed)	G06**
IR Extension to 2TΩ (factory installed)	G07**
DC hipot Upgrade (return to factory)	G08
IR Upgrade (return to factory)	G09
Corded Product Adaptor (115V)	G10
High Voltage Probe, 5 meters	G11
Probe Cable, Unterminated, 5 meters	G12

* in some cases referred to as Guardian I thru IV
** applies to Guardian 300 and 400 only

Section 1 Introduction

1.1 Unpacking and Inspection

Inspect the shipping carton before opening, if damaged contact the carriers agent immediately. Inspect the instrument for any damage. If the instrument appears damaged or fails to meet specifications notify QuadTech (refer to instruction manual front cover) or its local representative. Retain the shipping carton and packing material for future use such as returning for recalibration or service.

1.2 Product Overview

The Guardian is available in four models, all of which provide **AC hipot testing** capability. Additionally, the Guardian 200 provides **DC hipot testing,** the Guardian 300 **insulation resistance testing** and the Guardian 400 both **DC hipot and insulation resistance testing.** Each model comes with IEEE-488.2 and I/O port interfaces standard, for remote control operation and communication with other instrumentation. An RS-232 interface is available as an option.

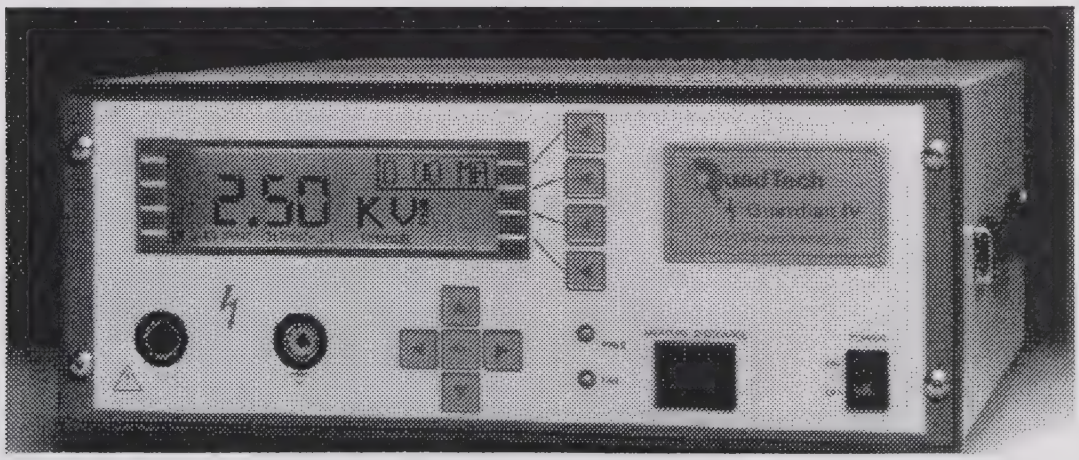


Figure 1-1
Guardian

1.3 Front Panel Description

Figure 1-2 shows the controls and indicators on the front panel of the Guardian. Table 1-1 identifies them with descriptions and functions.

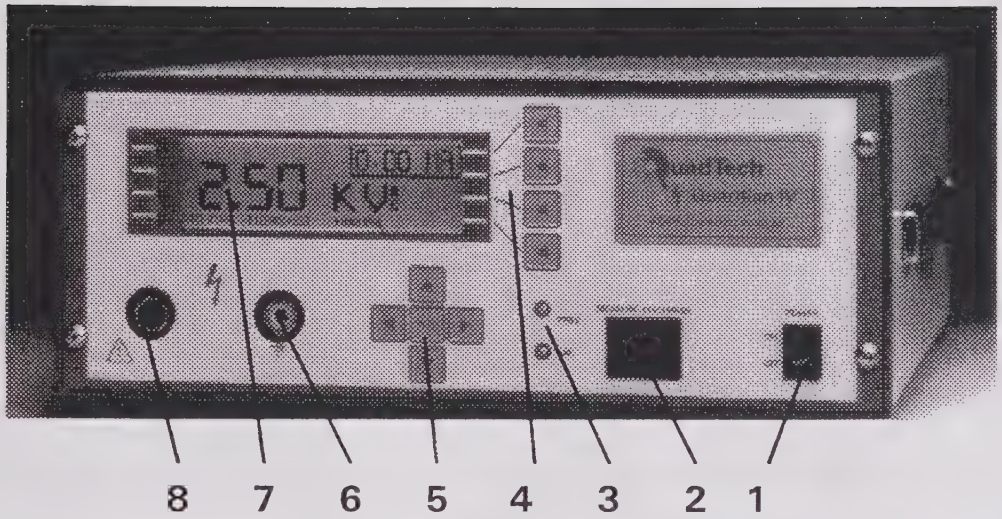


Figure 1-2
Front Panel Controls & Indicators

Table 1-1
Front Panel Controls and Indicators

Figure 1-2 Ref. No.	Item	Function
1	**Power Switch**	Rocker switch to turn power on or off.
2	**Measure/Discharge Switch**	Initiates or terminates a test, with red light to indicate when High Voltage is present.
3	**Pass/Fail Lights**	Green light and red light to indicate pass or fail according to programmed test limits.
4	**Function Keys (4)**	Function keys, the meaning of which is shown on the LCD display.
5	**Cursor Keys (5)**	Four cursor keys to change parameter and one enter key to enter parameter selection.
6	**Ground Connector**	Ground return connection for high voltage output.
7	**LCD Display**	Displays test conditions, measurement results and messages to operator
8	**High V Connector**	High voltage output connection.

1.4 Display Description

Dependent on position of the user and light conditions, it is possible to adjust the screen contrast by turning the potentiometer located on the rear panel, refer to Figure 1-4 for location. The display is backlite to improve use when light conditions are poor.

The screen is divided in 5 areas arranged as follows:

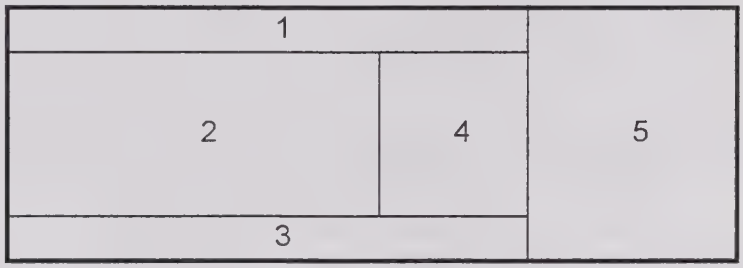


Figure 1-3
Display Areas

- area 1: help messages (in normal video mode) or error messages (in reverse video mode).
- area 2: display of the measurement results with big characters. In input parameters mode, display of test parameters for possible changes.
- area 3: recall of the measurement parameters.
- area 4: symbol recalling the selected test (MΩ, KV, ...)
- area 5: indicates the name of the function keys on the right hand side of the display.

1.5 Rear Panel Description

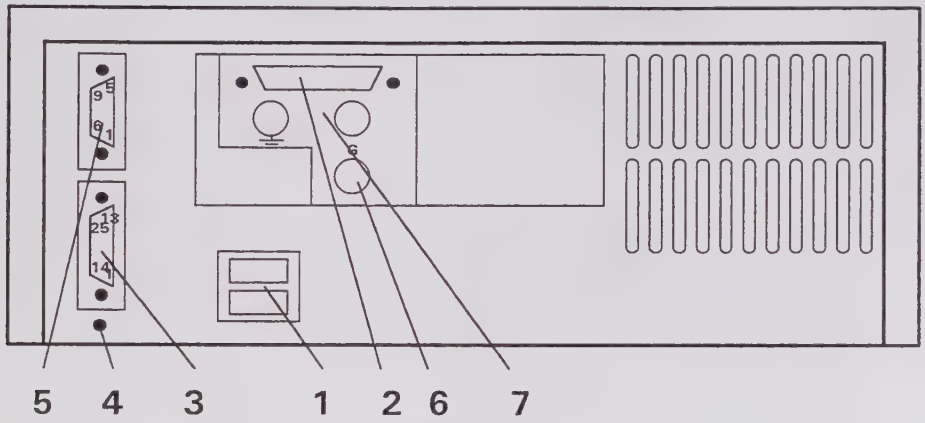


Figure 1-4
Rear Panel View

Table 1-2
Rear Panel Connectors and Controls

Figure 1-4 Ref. No.	Item	Function
1	**Power Connector**	AC power input, filtering, fusing and switching. Use with Belden SPH-386 socket or equivalent Contains 2 A fuse for 115V or 1 A fuse for 230V operation. Refer to paragraph 1.8.2.
2	**IEEE-488.2**	Input/output connections according to IEEE STD-488.2. 24 pin socket for standard IEEE-488 cable. Refer to paragraph 5.3.
3	**I/O Interface**	Safety interlock connector or connection to component handler. 25 pin Amp connector. Refer to paragraph 5.1.
4	**Contrast Adjust**	Adjustment for contrast of LCD display
5	**RS232 Connector (Optional)**	Connection according to RS232 std interface. Type DB9 (9 pin) female connector. Refer to paragraph 5.2.

Table 1-2 (continued)
Rear Panel Connectors and Controls

Figure 1-4

Ref. No.	Item	Function
6	**Guard Connector**	Megohmmeter guarded connection, banana type.
7	**Rear Connectors (Optional)**	Rear panel High Voltage and Ground connection (G04 option)

1.6 Accessories Included

Table 1-3

Item	Quantity
Instruction Manual	1
Calibration Certificate	1
Power Cord	1
Measurement Test Probe Cable (red)	1
Measurement Return Cable (black)	1
Interlock Connector (for I/O Interface connector)	1

1.7 Accessories/Options Available

Table 1-4

Item	Part Number
RS-232 Interface	G01
0/10 V Input/Output	G02
Rack Mount Kit	G03
Rear Panel Connection	G04
Probe Cable, Unterminated	G05
Custom IR Test Voltage (factory installed)	G06*
IR Extension to 2TΩ (factory installed)	G07*
DC Hipot Upgrade (return to factory)	G08
IR Upgrade (return to factory)	G09
Corded Product Adaptor (115V)	G10
High Voltage Probe, 5 meters	G11
Probe Cable, Unterminated, 5 meters	G12

* applies to Guardian 300 and 400 only

1.8 Installation

1.8.1 Instrument Positioning

The Guardian contains a high resolution back lit LCD for convenient viewing. The optimum angle for viewing is straight onto the display. This means that for bench operation the front feet should sometimes be used to angle the instrument up and for rack installation it should be mounted somewhat at eye level.

1.8.2 Power Requirements

The Guardian can be operated from either 115 or 230 volts. Before connecting the 3-wire power cord between the unit and AC power source make sure the voltage indicated on the rear panel power inlet module is in accordance with the power source to be used. **The instrument can be damaged if the wrong voltage is selected**. For a change of voltage selection proceed as follows:

- Front panel ON/OFF switch in the OFF position.
- Remove the power cord from the inlet module.

WARNING

MAKE SURE THE UNIT HAS BEEN DISCONNECTED FROM ITS AC POWER SOURCE FOR AT LEAST FIVE MINUTES BEFORE PROCEEDING.

- Using a small flathead screwdriver, remove the selection sub-assembly from the inlet module.
- Remove the fuses (the one in pale gray insert is the active fuse, other is a spare)
- Remove the pale gray plastic piece.
- Select voltage: 110 for a 115 volt source or 220 for a 230 volt source.
- Replace the gray plastic piece to display in the window of the sub-assembly the required voltage.
- Install proper fuse, 2 A for 115 V operation, 1 A for 230 V operation.
- Replace the selection sub-assembly in the inlet module
- Connect the power cord.

1.8.3 Safety Precautions

WARNING

NEVER TOUCH THE TIP OF THE HIGH VOLTAGE TEST PROBE WHEN THE PROBE IS CONNECTED TO THE INSTRUMENT AND THE RED HIGH VOLTAGE LIGHT IS ON.

WARNING

USE ALL PRECAUTIONS NECESSARY TO AVOID TOUCHING THE DEVICE UNDER TEST WHEN THE RED HIGH VOLTAGE LIGHT IS ON.

To improve safety for the operator the Guardian instrument is supplied with a "safety loop" interlock connector, preventing generation of the high voltage when pins 1 and 14 of the 25 pin I/O Interface connector, located on the rear panel, are not connected.

It is therefore advisable to put into operation interlock contacts whenever possible such as fixture closed door or safety cover to complete this connection. Refer to Figure 1-4 for connector location and pin configuration.

Section 2 General Operation

2.1 Startup

Connect the instrument power cord to the source of proper voltage. **The instrument is to be used only with three wire grounded outlets. The proper fuse must be installed as described in paragraph 1.8.2.**

Power is applied to the Guardian by pressing the **POWER** button on the front panel to the **ON** or **1** position.

2.2 Connection to Device Under Test

Insert the test probe (if not already installed) into the fixed high voltage connector (left) on the front panel and secure by tightening the black protective cover clockwise.

Connect the ground return cable into the fixed ground connector (right) on the front panel and secure by tightening the knurled ring clockwise.

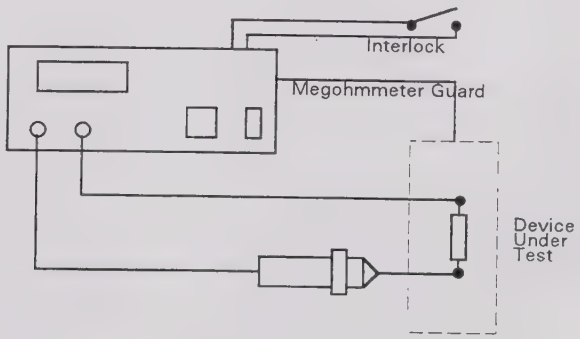


Figure 2-1
Connection to Device Under Test

WARNING

The driven megohmmeter guard (rear panel) on this instrument is at negative potential with respect to power ground. If this guard is connected to any exterior part of the device under test, shield, cover, or otherwise, this surface will contain high voltage dangerous to the user. Do not connect this guard terminal to ground, it can result in damage to the instrument.

2.3 Setup

2.3.1 Power-up Display

After switching the power on or pressing ESC from another display the instrument indicates the power-up display (Figure 2-2).

Figure 2-2
Power-up Display

2.3.2 Setup Display

After switching the instrument on or returning to the Power Up Display press the setup function key as shown below to access the Setup Menu.

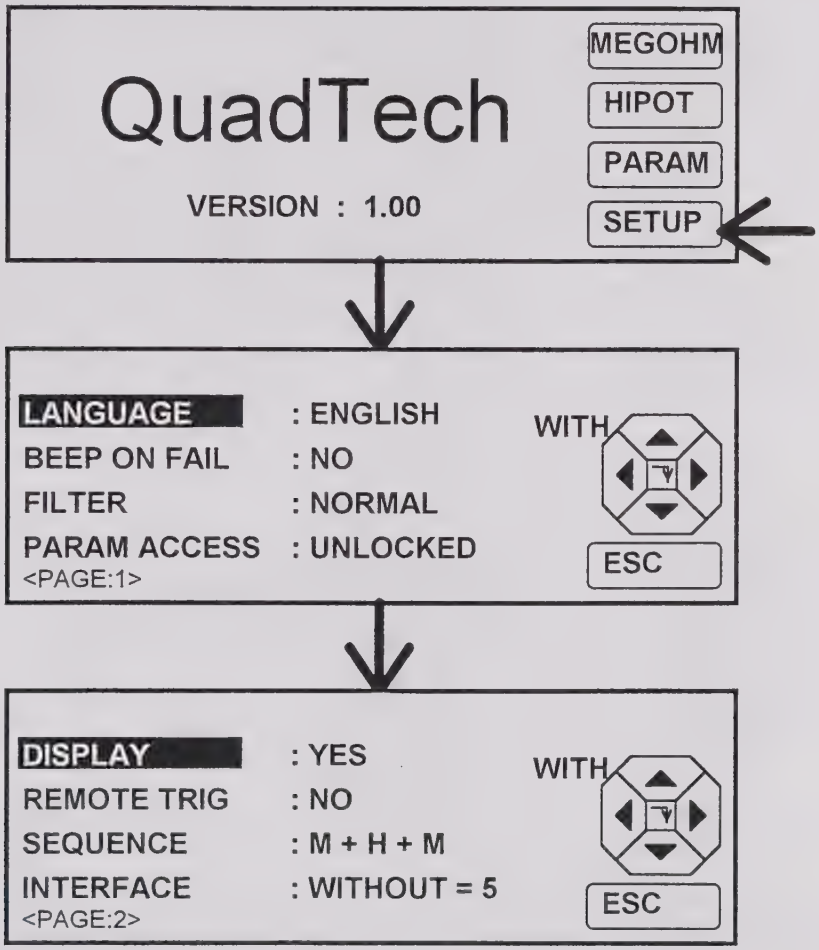


Figure 2-3
Setup Display

With the **UP/DOWN** arrow keys move the reverse video to the category desired for modification.

Press the **ENTER** key (center key) or **RIGHT** arrow key for the selections under the category.

Scroll the possible selections and select the one of choice by pressing the **ENTER** key.

LANGUAGE

All messages on the LCD display can be in English or French.

ENGLISH, when selected with the **UP/DOWN** arrow and **ENTER** displays this language.

FRENCH, when selected with the **UP/DOWN** arrow and **ENTER** displays this language.

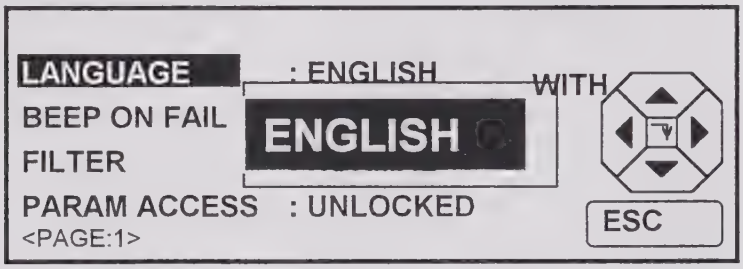


Figure 2-4
Language

BEEP ON FAIL

When test result is a failure, an audible sound is emitted by the unit until disabled by pressing the MEASURE/DISCHARGE light.

YES, when selected with **UP/DOWN** arrow enables the warning sound function.

NO, when selected with the **UP/DOWN** arrow disables the warning sound function.

The selection is retained in memory when the unit is switched off.

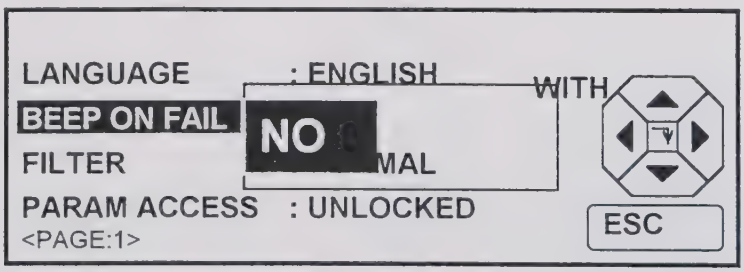
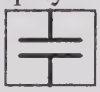


Figure 2-5
Beep on Fail

FILTER

Allows selection of measurement modes.

CAPACITOR, when selected with the **UP/DOWN** arrow allows for stable insulation resistance measurements on capacitive devices. During a DC Hipot test this mode employs averaging techniques to avoid voltage fluctuations and switches in the 1.5 Mohm discharge resistor at the beginning of the fall time to control the discharge voltage. When selected this mode is indicated by the symbol of a capacitor over the units in the measurement display.



NORMAL, when selected with the **UP/DOWN** arrow enables normal measurement response without the added averaging techniques of the capacitor mode.

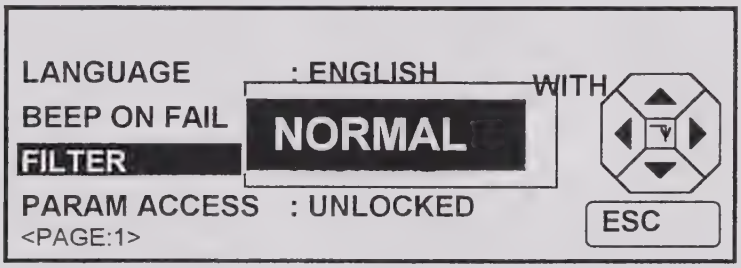


Figure 2-6
Filter

PARAM ACCESS

RECALL, when selected with the **UP/DOWN** arrow allows only recall of test parameters from memory without the ability to make modifications..

UNLOCKED, when selected with the **UP/DOWN** arrow allows recall of test parameters from memory as well as their modification.

LOCKED, when selected with the **UP/DOWN** arrow forbids recall of test parameters from memory or their modification. Any attempt to modify parameters in a forbidden mode will result in the message display, ACCESS DENIED.

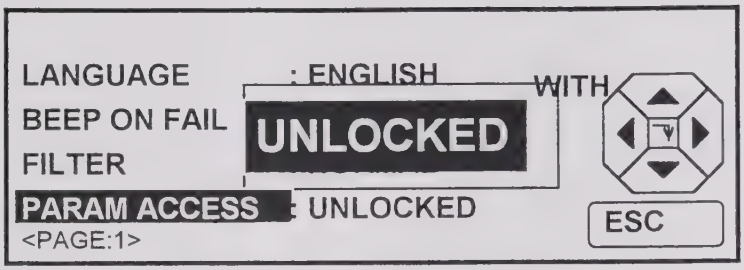


Figure 2-7
Parameter Access

DISPLAY

YES, when selected with **UP/DOWN** arrow enables the display of measurement results.

NO, when selected with the **UP/DOWN** arrow disables display of measurement results and displays only the Pass/Fail results. This mode is especially useful when controlling the instrument externally (IEEE-488, I/O, RS-232) since it results in reduced test time. When selected this mode is indicated by the symbol below in the measurement results display.

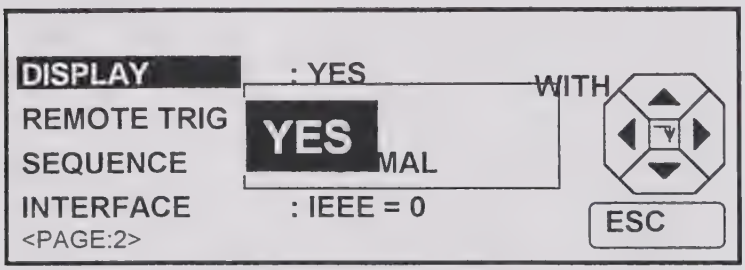


Figure 2-8
Display

REMOTE TRIG.

NO, when selected with **UP/DOWN** arrow disables the instrument's remote triggering capability.

YES, when selected with the **UP/DOWN** arrow allows measurement triggering to be remotely controlled. When selected this mode is indicated by the symbol below in the measurement results display.

WARNING

Carefully follow the procedure below to use the remote trigger.

- Connect the remote control device (contact closure) between pins 13 and 25 on the I/O connector.
- Select YES under REMOTE TRIG.
- Press ESC to return to the Power up display.
- Select measurement type MEGOHM or HIPOT.
- The remote control drawing symbol should be indicated and the front panel MEASURE - DISCHARGE button inoperative.
- Close the remote contacts, pin 13 and 25 and keep closed during the desired test time.
- Release the contact closure, pin 13 and 25, at the end of the desired test time.

IMPORTANT

When operating in the Remote Trigger mode, if the safety loop is open (pins 1 to 14) the measurement function is inhibited, however the unit will not indicate the error message INTERLOCK DISABLE.

If Remote Trigger is selected and pins 1 to 14 (safety loop) and pins 13 to 25 (remote) are already closed when selecting the measurement function, Megohm or Hipot, the following message is displayed: **INPUT ERROR**
and Remote Trigger is automatically disabled. Refer to the steps above for the correct procedure.

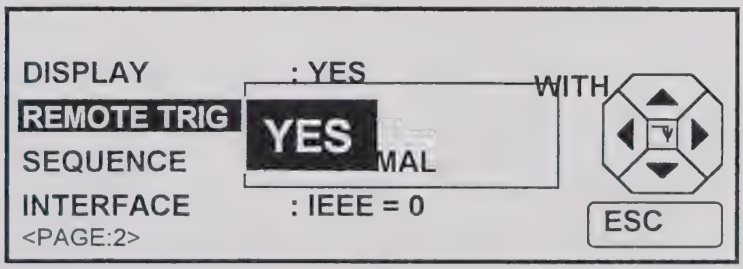


Figure 2-9
Remote Trigger

SEQUENCE

This feature allows for the various sequence modes to be performed automatically. The letter M indicates a Megohmmeter test and the letter H indicates a Hipot test. When selected this mode is indicated by the symbol below in the measurement results display.

OFF, when selected with **UP/DOWN** arrow disables the sequence function.

M + H + M, when selected with **UP/DOWN** arrow will result in Megohmmeter, Hipot and another Megohmmeter test performed in sequence.

H + M, when selected with **UP/DOWN** arrow will result in Hipot and Megohmmeter test performed in sequence.

M + H, when selected with **UP/DOWN** arrow will result in Megohmmeter and Hipot test performed in sequence.

For example, in a M + H sequence the unit performs first an insulation test and then a hipot test. It is necessary to set the parameters, especially the test times before running the sequence. If a failure occurs during the test, the sequence is stopped. When operating in sequence mode, at power up, the first function in the sequence is automatically selected. When attempting to trigger the measurement mode in a function which is note the first one in the sequence, the following message is displayed:

SEQUENCE ERROR

In this case select another function, megohmmeter or hipot, or another sequence.

Example of a typical sequence setup where one wants to perform an insulation test, then a hipot test and finally another insulation test to verify that the device hasn't been degraded by the hipot test.

- SETUP menu
- <page 2>, line SEQUENCE
- select the sequence mode: M + H + M
- escape with [ESC} key
- the unit switches automatically in the insulation test
- check that parameters are correct (necessary to select times)
- press on the [MEASURE / DISCHARGE] button
- after the test time the unit switches automatically to the next test if the test result as PASS.

- when an insulation test has to be performed after a hipot test, the unit controls the discharge voltage of the device and follows its sequence only if the voltage is lower than 100 volts with the display of:

DISCHARGE CONTROL

In case of a failure during the insulation test, the number 1 or 2 test is displayed. At the end of a sequence, after release of the result by pressing the [MEASURE / DISCHARGE] button the unit switches in the first function of the sequence.

To escape the setup menu, press the function key [ESC].

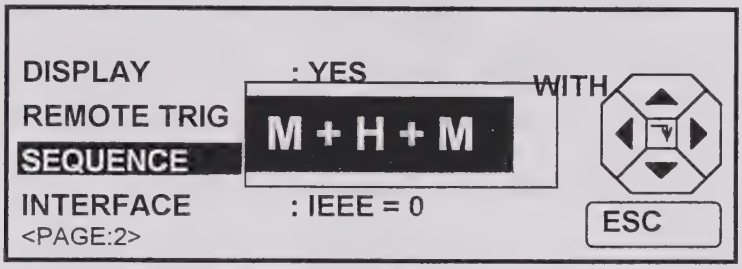


Figure 2-10
Sequence

INTERFACE
Allows entry of address for the selected interface.

OFF, when selected with the **UP/DOWN** arrow selects no interface for addressing.

IEEE, when selected with the **UP/DOWN** arrow selects the IEEE-488 interface and its address, standard on all units. With **RIGHT** arrow moves the reverse video to the address units. Increase or decrease the value of either digit with the **UP/DOWN** arrow. The address can be set to a value between 0 and 31.

RS232, when selected with the **UP/DOWN** arrow selects the RS-232 interface when this optional interface is available in the unit.

PLC, when selected with the **UP/DOWN** arrow selects the I/O interface, standard on all units.

Important: Interfaces should be disabled when not in use.

When using remote control it is necessary to select the interface being used on this line. When pressing the ENTER key, if the option is not installed in the unit, the following message is displayed:

MISSING OPTION

For more information regarding the remote control modes, please refer to Section 5 of this manual.

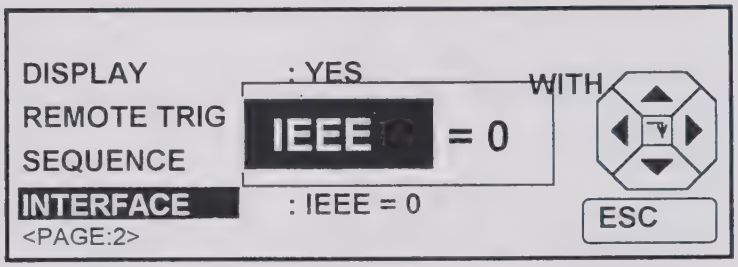


Figure 2-11
Interface

Section 3 Hipot Operation

3.1 Hipot Measurement

Select the test voltage, current thresholds, breakdown detection mode and time parameters as described in paragraphs of 3.2 or select parameters stored in memory as described in paragraph 3.3.

WARNING

ALWAYS MAKE SURE THE HIGH VOLTAGE INDICATOR IS NOT ON WHEN CONNECTING OR DISCONNECTING THE DEVICES UNDER TEST.

- Connect the device under test as described in paragraph 2.2.
- Press the **MEASURE/DISCHARGE** button.

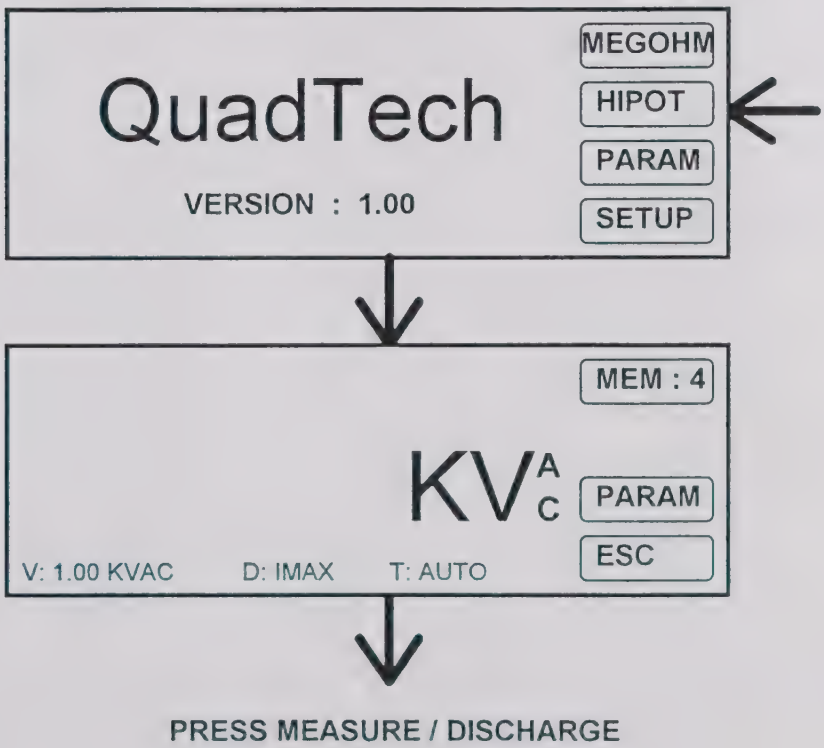


Figure 3-1
Hipot

- The indicator inside the button is illuminated and the display shows:

Figure 3-2
Measure

In the case where the MANUAL test time mode has been selected, the unit remains in the measurement mode permanently until the MEASUREMENT/DISCHARGE key is pressed. Use the UP key to increase the test voltage and the DOWN key to decrease the test voltage. The maximum voltage which can be reached is that listed on the bottom of the display or lower depending on the impedance of the device under test.

In the case where the AUTO test time mode has been selected, every second the value of the RISE time counts down one unit, then the value of the HOLD time and last the value of the FALL time. When FALL time reaches 0 the output voltage is cut off automatically, the leakage current is compared to the IMAX and IMIN limits and the red FAIL or green PASS light illuminated.

In either mode (AUTO or MANUAL) if the leakage current through the device under test exceeds the breakdown detection values (DELTA I or IMAX) the unit declares breakdown and cuts off the high voltage (at next zero crossing). The display shows:

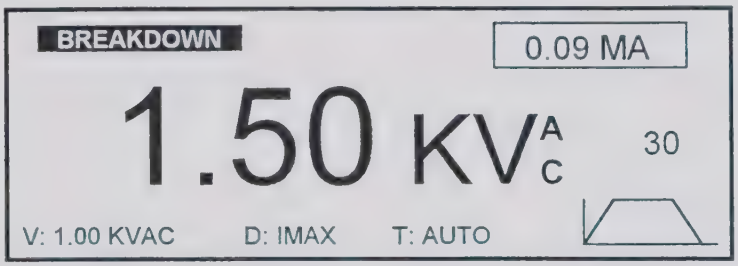


Figure 3-3
Results

The voltage and leakage current at breakdown is retained on the display.

- Press the MEASURE/DISCHARGE key to cancel the memorization display (the high voltage indicator goes out).

- Press ESC key to escape the function.

3.2 Hipot Parameters

Allows test parameter modification for all hipot functions as shown in Figure 3-1. If ACCESS DENIED appears, parameter modification has previously been denied, refer to paragraph 2.3.2.

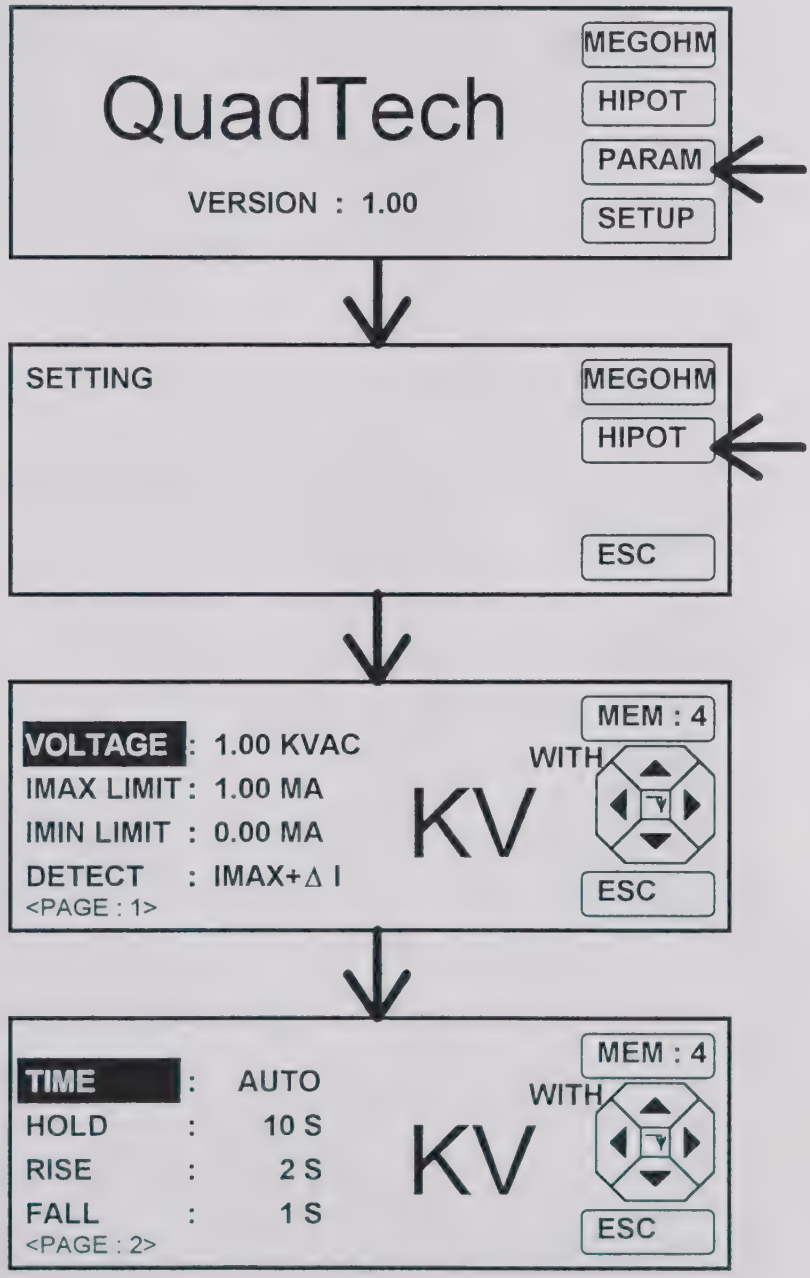


Figure 3-4
Hipot Parameter Display

3.2.1 Voltage

The instrument provides test voltages between 100 and 5000 VAC and between 100 and 6000 VDC for **Guardian 200** and **Guardian 400**.

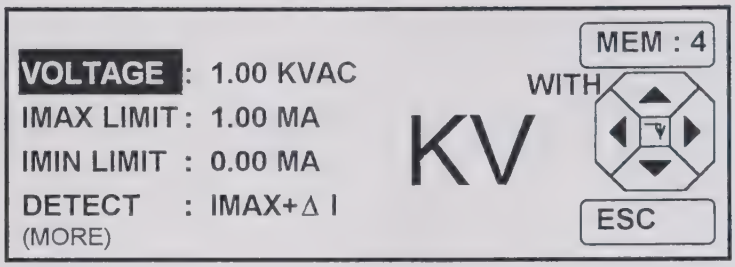


Figure 3-5
Voltage

The test voltage selection is changed as follows:

- With **UP/DOWN** arrow keys move the reverse video to **VOLTAGE**.
- Press **RIGHT** arrow or **ENTER** and display shows:

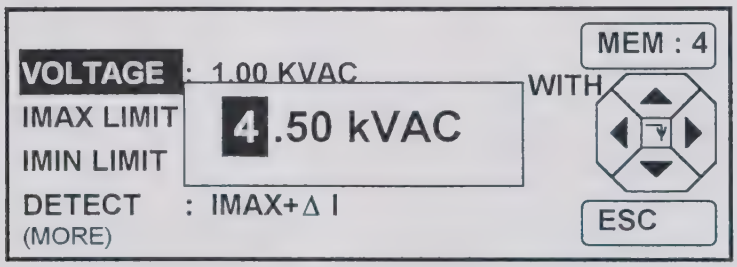


Figure 3-6
Voltage Modify

- Select the number to be modified by moving the **RIGHT/LEFT** arrow.
- Increase of decrease the value with the **UP/DOWN** arrow (0,1,2,3,4,5, 6,7,8,9,.,0,1,2,3, etc.).
- Repeat the operation for modification of any other digits as desired.
- With RIGHT arrow move the reverse video to the voltage units.
- For **Guardian 200** and **Guardian 400** only, use **UP/DOWN** arrow key to select **AC** or **DC** and press **ENTER**.

Note: For any value higher than the maximum allowed, 5.00 AC or 6.00 DC the error message **LIMIT ERROR** will appear. Enter a correct value.

3.2.2 I Max Limit

The instrument provides two operator programmable limits for checking a device under test to be good or bad according to these limits.

I Max Limit defines the maximum current which is allowed to flow through the device under test. This limit is operator programmable between 0.00 mA and 9.99 mA. A device is considered good (PASS) if the current is less than the I Max Limit and greater than the I Min Limit (see paragraph 3.2.3).

- Select the number to be modified by moving the **RIGHT/LEFT** arrow.
- Increase or decrease the value with the **UP/DOWN** arrow (0,1,2,3,4,5, 6,7,8,9,.,0,1,2,3, etc.).
- Repeat the operation for modification of any other digits as desired.
- Press **ENTER** to finalize threshold limit.

Note: The I Max Limit must always be higher than the I Min Limit, otherwise the error message **I MAX LIMIT < I MIN LIMIT** will appear.

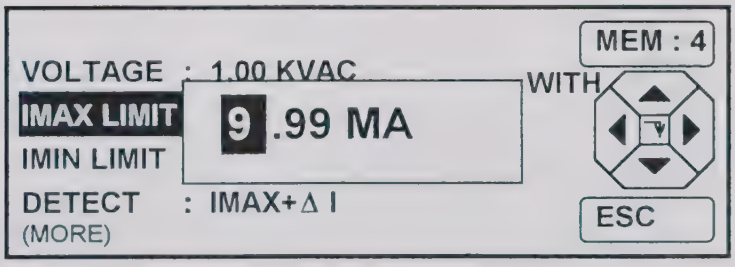


Figure 3-7
Imax Limit

3.2.3 I Min Limit

The instrument provides two operator programmable limits for checking a device under test to be good or bad according to these limits.

I Min Limit defines the minimum current which must flow through the device under test. This limit is operator programmable between 0.00 mA and 9.99 mA. A device is considered good (PASS) if the current is greater than the I Min Limit and less than the I Max Limit (see paragraph 3.2.2).

An I Min Limit set to 0.00 mA cancels the minimum current threshold.

- Select the number to be modified by Moving the **RIGHT/LEFT** arrow.
- Increase or decrease the value with the **UP/DOWN** arrow (0,1,2,3,4,5, 6,7,8,9,.,0,1,2,3, etc.).
- Repeat the operation for modification of any other digits as desired.
- Press **ENTER** to finalize threshold limit.

Note: The I MIN Limit must always be LESS than the I Max Limit, otherwise the error message **I MIN LIMIT > I MAX LIMIT** will appear.

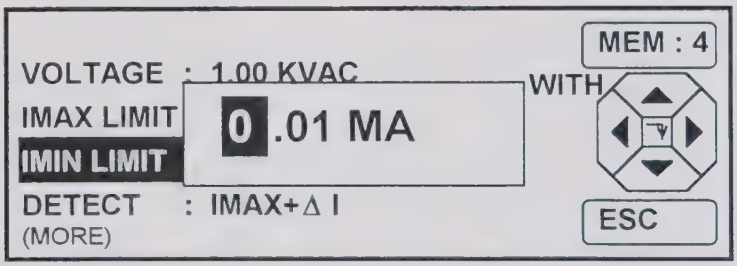


Figure 3-8
Imin Limit

3.2.4 Detect

The Detect mode provides flexibility in selecting variations in detector response during the Hipot test. These are discussed in more detail below.

IMAX

This detector mode monitors the constant leakage current flowing through the device under test and compares this current to the **operator entered limit IMAX.** This mode does not perform fast arc detection and its relative slow response time can be destructive to some devices under test.

Note: Response time for Imax is approximately 400 ms.

DELTA I (ΔI)

This detector mode monitors arcs having a minimum width of **10 μs and an amplitude of 1 mA.**, no operator enter adjustment is necessary. Its fast response time limits any possible damage to the device under test, but it does not locate a fault on a device already short circuited at the beginning of a test.

IMAX + DELTA I

This mode is a **combination of the two previous detection modes** and often the preferred detection mode.

OFF

The IMAX and/or DELTA I **detection modes are disabled**, i.e. current is not monitored and voltage does not cut off.

WARNING

This BURNING mode is limited to 5 seconds, in which case over heating will result in a thermal switch causing the high voltage to shut down. If this happens wait for 3 to 5 minutes before proceeding. There is not automatic adjustment of output voltage to load impedance in this mode.

The detector response mode is changed as follows:

- With **UP/DOWN** arrow keys move the reverse video to **DETECT**.
- Press **RIGHT** arrow or **ENTER** and display shows :

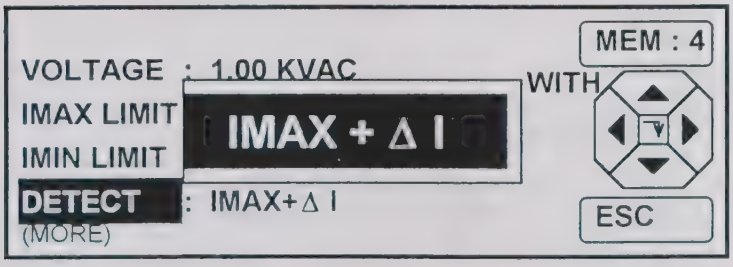


Figure 3-9
Detector

- With **UP/DOWN** arrow keys select the desired detection mode and press **ENTER**.

3.2.5 Time

To avoid sudden application of voltage and place excess stress on the device under test, it is possible to produce the following measurement cycle where the rise and fall times are under programmed control.

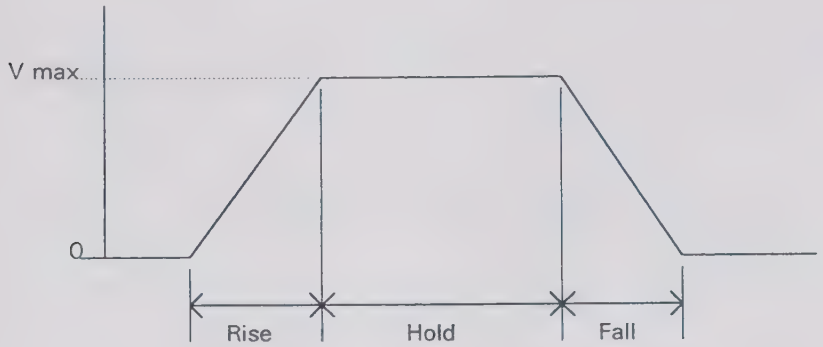


Figure 3-10
Measure Cycle

There are two possible ways to control the measurement test cycle, these being AUTO and MANUAL. In Auto is possible to set the rise, hold and fall times from 0 to 999 seconds to control the cycle automatically. In Manual one must increase or decrease the output test voltage as desired by repetitively pressing the UP or DOWN keys. It is necessary to press the key for each voltage step.

- With **UP/DOWN** arrow keys move the reverse video to **TIME**.
- Press **RIGHT** arrow or **ENTER** and display shows :

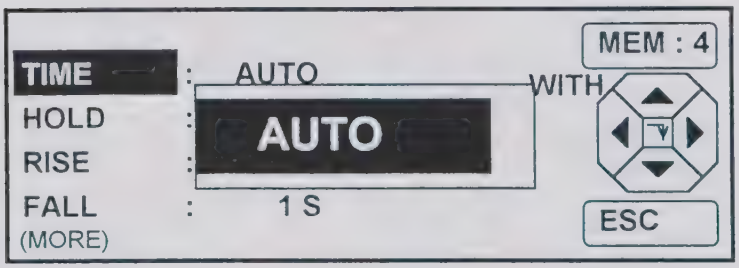


Figure 3-11
Time

- With **UP/DOWN** arrow keys select the desired time mode and press **ENTER**.

In Auto it is possible to set the RISE, HOLD and FALL times for 0 to 999 seconds, refer to paragraphs 3.2.6, 3.2.7 and 3.2.8 below.

Note: Test time is approximately 600 ms (to EOT) with all times set to 0.

3.2.6 Hold

- With **UP/DOWN** arrow keys move the reverse video to **HOLD**.
- Press **RIGHT** arrow or **ENTER** and display shows :

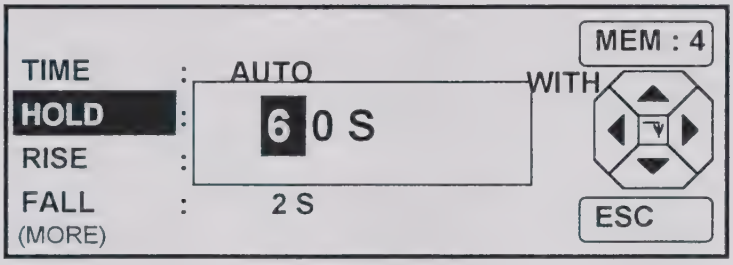


Figure 3-12
Hold Time

- Increase of decrease the value with the **UP/DOWN** arrow (0,1,2,3,4,5, 6,7,8,9,.,0,1,2,3, etc.).
- Repeat the operation for modification of any other digit as desired.
- Press **ENTER** to finalize Hold time.

3.2.7 Rise

- With **UP/DOWN** arrow keys move the reverse video to **RISE**.
- Press **RIGHT** arrow or **ENTER** and display shows :

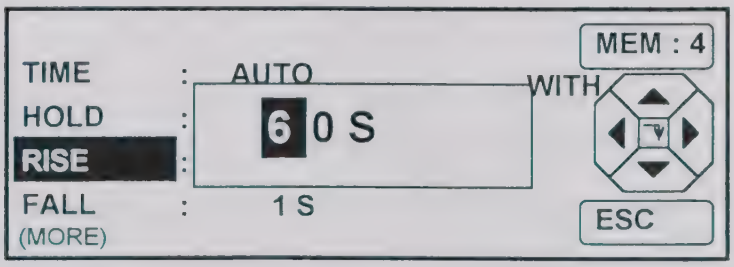


Figure 3-13
Rise Time

- Increase of decrease the value with the **UP/DOWN** arrow (0,1,2,3,4,5, 6,7,8,9,.,0,1,2,3, etc.).
- Repeat the operation for modification of any other digit as desired.
- Press **ENTER** to finalize Rise time.

3.2.8 Fall

- With **UP/DOWN** arrow keys move the reverse video to **FALL**.
- Press **RIGHT** arrow or **ENTER** and display shows :

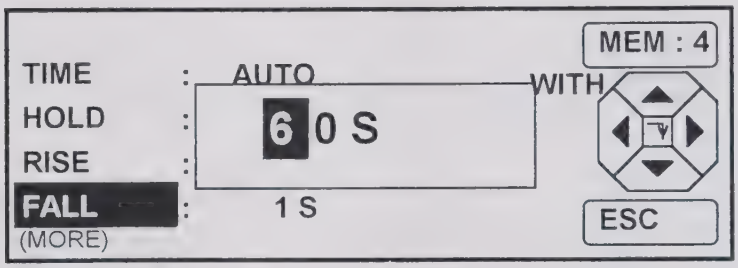


Figure 3-14
Fall Time

- Increase of decrease the value with the **UP/DOWN** arrow (0,1,2,3,4,5, 6,7,8,9,.,0,1,2,3, etc.).
- Repeat the operation for modification of any other digit as desired.
- Press **ENTER** to finalize Fall time.

3.3 Test Parameter Storage

This feature allows the instrument to store 10 sets of test parameters in internal memory for later recall. The stored parameters are discussed in the previous paragraph, 3.2.

From the **Hipot measurement display** select the memory location desired as follows:

- Press the **MEM:X** function key and display shows:

Figure 3-15
Store

- With **UP/DOWN** arrow key increase or decrease the memory location number (0 to 9). Parameters for the selected memory location are indicated on the lower portion of the screen.

- Enter the selected memory either by pressing again on the **MEM:X** function key or by pressing the **ENTER** key

From the **Hipot parameter display** select the memory location desired as follows:

- Press the **MEM:X** function key and display shows:

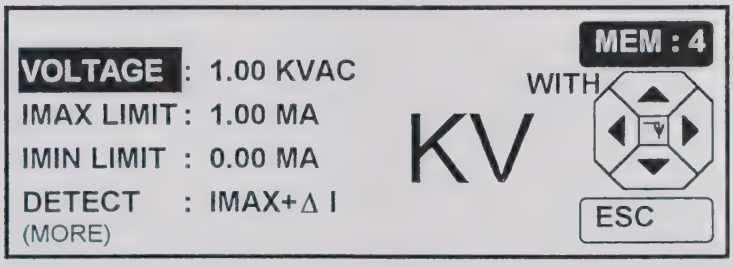


Figure 3-16
Store Parameters

- With **UP/DOWN** arrow key increase or decrease the memory location number (0 to 9). Parameters for the selected memory location are indicated on the left of the display.

- Enter the selected memory either by pressing again on the **MEM:X** function key or by pressing the **ENTER** key

WARNING

ANY PARAMETER MODIFICATION IS AUTOMATICALLY STORED IN THE MEMORY.

3.4 Error Messages

The following error messages may appear during the measurement:

- INTERLOCK DISABLE: the safety loop is not closed. There is no connection between pins 1 and 14 and 13 and 25 on the I/O Interface connector.

- VOLTAGE ERROR: the test voltage has not reached its final value (impedance of the device under test may be too low). In DC voltage wait for the end of the charge, in AC voltage check the current specifications of the power supply. In case of over heating a built-in thermal switch cuts off the high voltage generator. Wait 3 - 5 minutes before going on.

- I < IMIN: during HOLD time, the leakage current through the device under test has not reached the minimum value set by the IMIN parameter (bad connection to the test probe is possible). This fault gives a FAIL test result even if no breakdown occurs.

- BOARD NOT READY: the instrument microprocessor board can not communicate with the hipot test board. Consult QuadTech Service.

- SYNCHRO ERROR: the hipot test board is not able to generate the sinusoidal signal which drives the high voltage transformer. Consult QuadTech Service.

Section 4 Megohmmeter Operation

4.1 Megohmmeter Measurement

Select the test voltage, current thresholds, breakdown detection mode and time parameters as described in paragraphs of 4.2 or select parameters stored in memory as described in paragraph 4.3.

WARNING

ALWAYS MAKE SURE THE HIGH VOLTAGE INDICATOR IS NOT ON WHEN CONNECTING OR DISCONNECTING THE DEVICES UNDER TEST.

- Connect the device under test as described in paragraph 2.2.
- Press the **MEASURE/DISCHARGE** button.

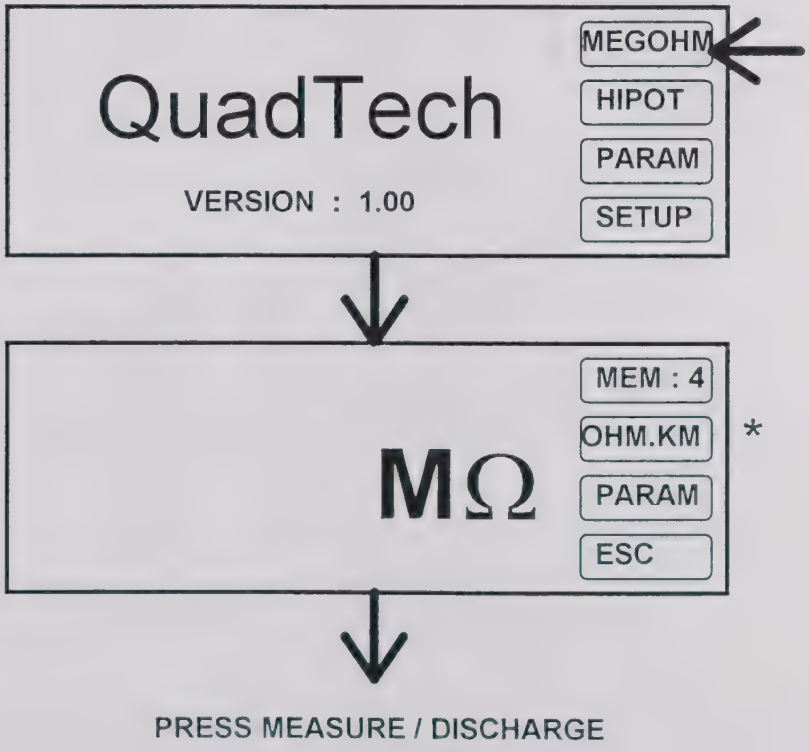


Figure 4-1
Megohmmeter

* Displays resistance as function of cable length, refer to paragraph 4.4.

- The indicator inside the button is illuminated and the display shows:

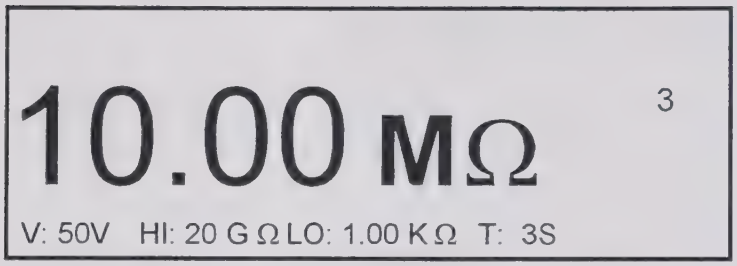


Figure 4-2
Measure

In the case where the test time is set to 0, the unit remains in the measurement mode permanently until the MEASUREMENT/DISCHARGE key is pressed.

In the case where a test time value has been selected, every second the value of the test time counts down one unit. When the displayed time reaches 0 the output voltage is cut off automatically, the last measured value is retained on the display, compared to the HIGH and LOW limits and the red FAIL or green PASS light illuminated.

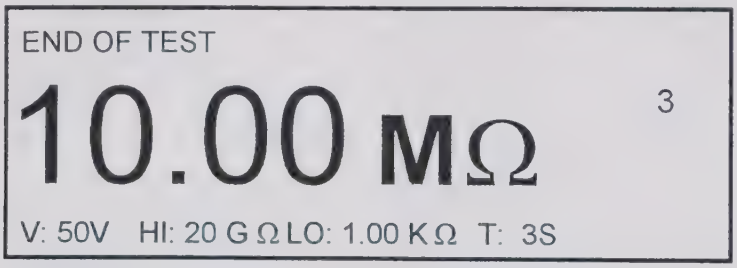


Figure 4-3
Results

- Press the MEASURE/DISCHARGE key to cancel the memorization display (the high voltage indicator goes out).

- Press ESC key to escape the function.

4.2 Megohmmeter Parameters

Allows test parameter modification for all megohmmeter functions as shown in Figure 4-4. If ACCESS DENIED appears, parameter modification has previously been denied, refer to paragraph 2.3.2.

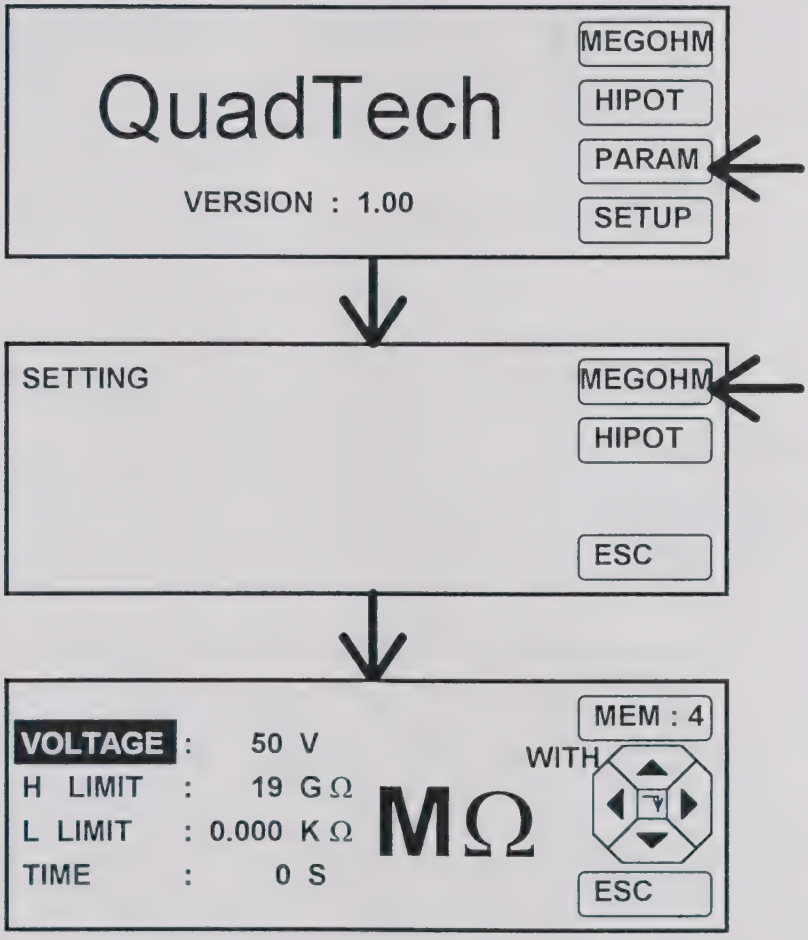


Figure 4-4
Megohmmeter Parameter Display

4.2.1 Test Voltage

The instrument provides four test voltages; 50, 100 , 250 and 500 VDC. The selection is done according to the requirements of the device under test.

The test voltage selection is changed as follows:

- With **UP/DOWN** arrow keys move the reverse video to **VOLTAGE**.
- Press **RIGHT** arrow or **ENTER** and display shows :

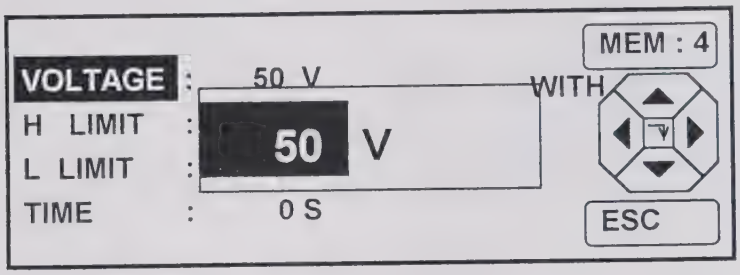


Figure 4-5
Voltage

- With **UP/DOWN** arrow keys select the desired voltage and press **ENTER**.

4.2.2 High Limit

The instrument provides two operator programmable limits for checking a device under test to be good or bad according to these limits.

Hi Limit defines the maximum insulation resistance value for the device under test and the Lo Limit defines the minimum insulation resistance value for the device under test. A device is considered good (PASS) if the insulation resistance is less than the Hi Limit and greater than the Lo Limit. The limits are adjustable from 0.000 kohms to 200.0 Gohms. A Hi Limit set to 200.0 Gohms cancels this limit and a Lo Limit set to 0.000 kohm cancels this limit.

- With **UP/DOWN** arrow keys move the reverse video to **H LIMIT**.
- Press **RIGHT** arrow or **ENTER** and display shows :

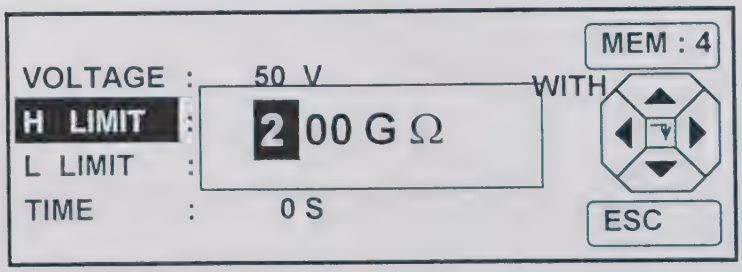


Figure 4-6
High Limit

- Select the number to be modified by moving the **RIGHT/LEFT** arrow.
- Increase of decrease the value with the **UP/DOWN** arrow (0,1,2,3,4,5, 6,7,8,9,.,0,1,2,3, etc.).
- Repeat the operation for modification of any other digit as desired.
- Press **RIGHT** arrow key to move the reverse video to units.
- With **UP/DOWN** arrow key select the desired units, **kΩ, MΩ, GΩ or TΩ,**
- Press **ENTER** to finalize the Hi Limit.

NOTE
The Hi Limit must always be greater than the low limit, otherwise error message displayed is **HI LIMIT < LO LIMIT**

4.2.3 Low Limit

- With **UP/DOWN** arrow keys move the reverse video to **L LIMIT**.
- Press **RIGHT** arrow or **ENTER** and display shows :

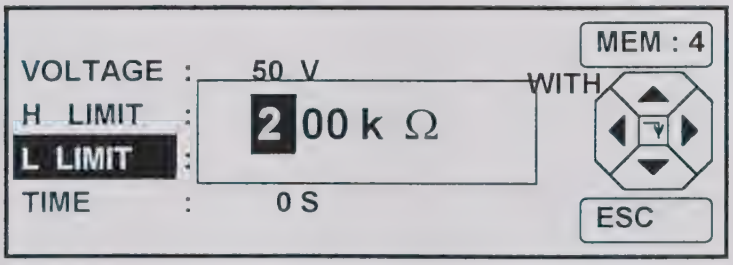


Figure 4-7
Low Limit

- Select the number to be modified by moving the **RIGHT/LEFT** arrow.
- Increase of decrease the value with the **UP/DOWN** arrow (0,1,2,3,4,5, 6,7,8,9,.,0,1,2,3, etc.).
- Repeat the operation for modification of any other digit as desired.
- Press **RIGHT** arrow key to move the reverse video to units.

- With UP DOWN arrow key select the desired units, kΩ, MΩ, GΩ or TΩ.

- Press ENTER to finalize the Lo Limit.

NOTE

The Lo Limit must always be less than the high limit, otherwise error message displayed is **LO LIMIT > HI LIMIT**

4.2.4 Time

The instrument provides an internal timer which defines the insulation resistance measurement time, from 1 to 999 seconds. This feature is particularly useful when measuring capacitive devices where the insulation resistance value increases as a function of the measurement time. At the end of the set measurement time the instrument will automatically stop the test and retain the last measured value on the LCD display.

When the test time is set to 0, the instrument will remain in a permanent measure mode until the **MEASURE / DISCHARGE** is pressed.

- With UP/DOWN arrow keys move the reverse video to TIME.

- Press **RIGHT** arrow or **ENTER** and display shows :

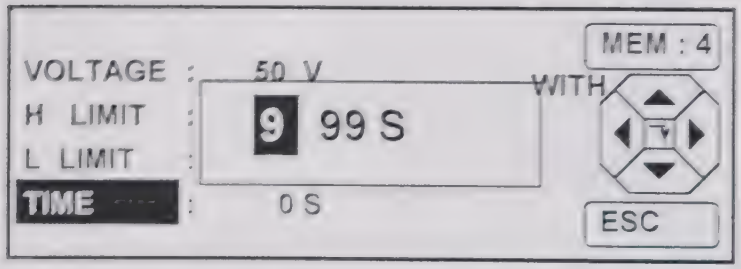


Figure 4-8
Time

- Select the number to be modified by moving the **RIGHT/LEFT** arrow.

- Increase of decrease the value with the **UP/DOWN** arrow (0,1,2,3,4,5, 6,7,8,9,.,0,1,2,3, etc.).

- Repeat the operation for modification of any other digit as desired.

- Press **ENTER** to finalize the Time.

4.3 Test Parameter Storage

This feature allows the instrument to store 10 sets of test parameters in internal memory for later recall. The stored parameters are discussed in the previous paragraph, 4.2.

From the **Megohmmeter measurement display** select the memory location desired as follows:

- Press the **MEM:X** function key and display shows:

.

Figure 4-9
Store

- With **UP/DOWN** arrow key increase or decrease the memory location number (0 to 9). Parameters for the selected memory location are indicated on the lower portion of the screen.

- Enter the selected memory either by pressing again on the **MEM:X** function key or by pressing the **ENTER** key

From the **Megohmmeter parameter display** select the memory location desired as follows:

- Press the **MEM:X** function key and display shows:

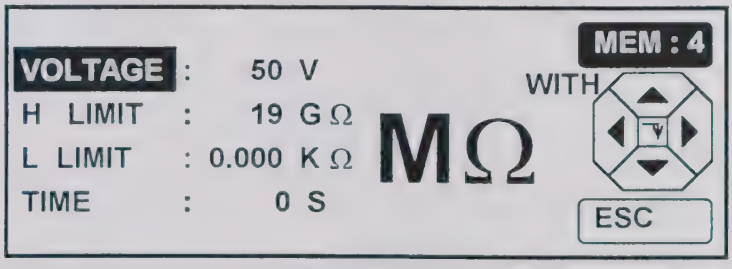


Figure 4-10
Store Parameters

- With **UP/DOWN** arrow key increase or decrease the memory location number (0 to 9). Parameters for the selected memory location are indicated on the left of the display.

- Enter the selected memory either by pressing again on the **MEM:X** function key or by pressing the **ENTER** key

ANY PARAMETER MODIFICATION IS AUTOMATICALLY STORED IN THE MEMORY.

4.4 OHM.KM Calculation

This feature allows the display of insulation resistance measurements calculated to 1 km (or 1 mi) for 1 wire. Menu entry provides for entry of cable length and the number of wires in parallel. The displayed result is shown in Mohm/km (or mi). This result is based on the number of conductors measured in parallel, the length of the cable and the measured resistance value. For example, the resistance of a 1 km cable can be determined based on the measurement of a 3 meter cable.

$$\text{R Displayed} = \frac{(\text{R Measured}) \times (\#\ \text{Conductors}) \times (\text{Length of Cable})}{\text{km (or mi)}}$$

Example: A measured value of 10 Mohms, on a 10 km cable with 10 conductors.

$$\text{R Displayed} = \frac{10\ \text{Mohms} \times (10) \times (10)}{\text{km}} = 1000\ \text{Mohms/km}$$

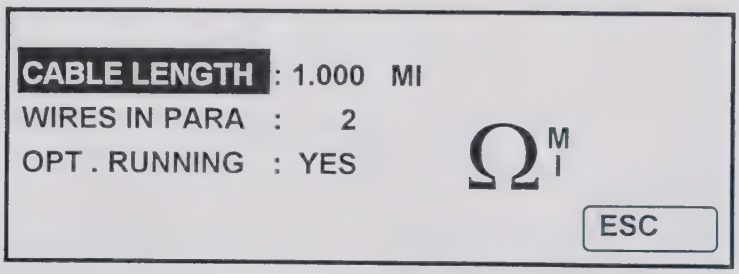


Figure 4-11
OHM.KM Parameters

CABLE LENGTH

- Press **RIGHT** arrow or **ENTER** to display cable length entry field.
- Select the number to be modified by moving the **RIGHT/LEFT** arrow.
- Increase of decrease the value with the **UP/DOWN** arrow (0,1,2,3,4,5, 6,7,8,9,.,0,1,2,3, etc.).

- Repeat the operation for modification of any other digit as desired.
- Press **RIGHT** arrow key to move the reverse video to units.
- With **UP/DOWN** arrow key select the desired units, **kM or MI.**
- Press **ENTER** to finalize the cable length.

 # WIRES IN PARALLEL

- With **UP/DOWN** arrow keys move the reverse video to **WIRES IN PARA.**
- Press **RIGHT** arrow or **ENTER** to display wires in parallel entry field.
- Select the number to be modified by moving the **RIGHT/LEFT** arrow.
- Increase of decrease the value with the **UP/DOWN** arrow (0,1,2,3,4,5, 6,7,8,9,.,0,1,2,3, etc.).
- Repeat the operation for modification of any other digit as desired.
- Press **ENTER** to finalize the number of wires in parallel.

CALCULATED DISPLAY OPTION

- With **UP/DOWN** arrow keys move the reverse video to **OPT. RUNNING.**
- Press **RIGHT** arrow or **ENTER** to display entry field.
- With **UP/DOWN** arrow key select **YES or NO.** Selection of YES results in the calculated display based on cable length and # of wires and NO results in the normal measured display.
- Press **ENTER** to finalize the cable length.

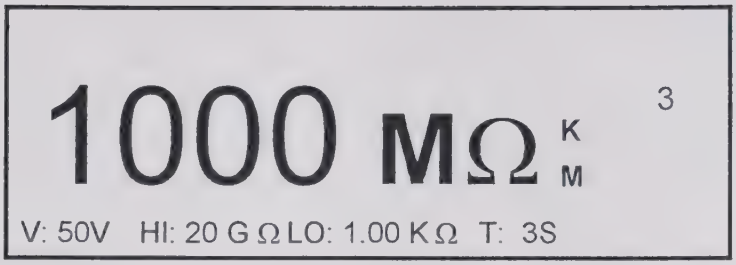


Figure 4-12
OHM.KM Calculated Display

Note: When the OHM.KM option is selected the Megohmmeter Hi/Lo Limits apply to the calculated display.

4.5 Error Messages

The following error messages may appear during the measurement:

- INTERLOCK DISABLE: the safety loop is not closed. There is no connection between pins 1 and 14 and 13 and 25 on the I/O Interface connector.

- OVER-RANGE: the resistance of the device under test exceeds the measurement specification of the unit.

- UNDER-RANGE: the resistance of the device under test is lower than the measurement specification of the unit.

- CHARGING: the test voltage has not yet reached its final value. On capacitive devices wait for the end of the charge, for resistive devices check the current specifications of the power supply.

- BOARD NOT READY: the instrument microprocessor board can not communicate with the hipot test board. Consult QuadTech Service.

Section 5 Input/Output Interface

5.1 I/O Interface

The Guardian comes standard with I/O interface port available through a 25 pin rear panel connector. Refer to Figure 1-4.

5.1.1 I/O Interface Connections

This interface provides for remote operation; signal names, pin numbers and functions are listed below.

Note: For remote operation the instrument must be returned to its Power-up Display (Paragraph 2.3.1)

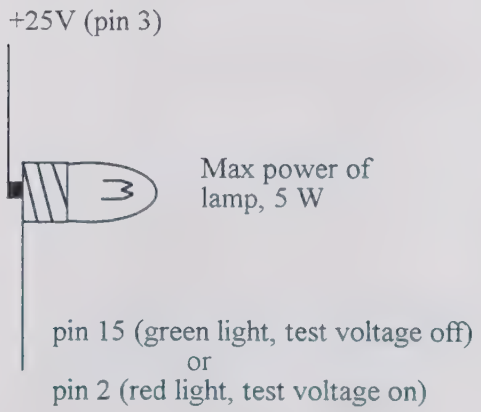
Table 5-1
I/O Interface Connections

Signal Name	Pin Number	Function
	Input:	
COM_IN	16	Electrical common between input signals
CTRLIN	4	Request for remote control of the measurement unit
TYPE	19	Measurement function, HI megohmmeter, LO hipot
MES_DCH	7	Measurement state, HI measure, LO discharge
N0	17	Binary code (1) stored setup in memory
N1	5	Binary code (2) stored setup in memory
N2	18	Binary code (4) stored setup in memory
N3	6	Binary code (8) stored setup in memory
Safety loop	1	Connect to pin 14
Safety loop	14	Connect to pin 1
Remote	13	Connect to 25
Remote	25	Connect to 13
+25V	3	+25 Volts, fuse protected
GROUND	12	0 Volt reference (ground)

Table 5-1 (continued)
I/O Interface Connections

Signal Name	Pin Number	Function
	Output:	
COM_OUT	8	Electrical common between output signals
CTRLOUT	21	Validation of the CTRLIN signal
EOT	22	Relay contact closed at end of test
PASS	10	Relay contact closed when test passes
FAIL	9	Relay contact closed when test fails
ERROR	23	Relay contact closed when error occurs (CHARGE, OVERLOAD, OVERVOLTAGE, BOARD NOT READY, SYNCHRO ERROR, INTERLOCK DISABLE, VOLTAGE ERROR)
RED	2	Connected to ground when test voltage is on
GREEN	15	Connected to ground when test voltage is off
0 - 10V	11	Optional analog output, 0 to 10V
0 - 10V	24	Optional analog output, 0 to 10V

Connection For External High Voltage Indicators



5.1.2 Electrical Characteristics

Input:

High state, optoisolated DC or AC, amplitude between Vmin and Vmax
Low state, no voltage
Input resistance - 1.5 kohms
Vmin - 11VDC or 8VAC
Vmax - 43VDC or 30VAC

Output:

High state, closed contact
Low state, open contact
Vmax - 70VDC
Max power - 30W
Max current - 0.15ADC

5.1.3 Measure/Discharge Cycles

The I/O function must be selected in the Setup Display menu under **Interface: PLC**
To take control of the unit (sequence function to OFF) the instrument must display the power-up screen.
To take control of the unit (sequence enabled) the instrument must display the first sequence function, megohmmeter or hipot.

To perform measurement:

- CTRLIN must be logic high state
- the programmable logic controller must choose a measurement function, Hipot or Megohmmeter (Guardian 300 and 400). This requires the input TYPE to be a logic high for megohmmeter or low for hipot.
- the programmable logic controller must choose the parameter setup stored in memory with the N0 thru N3 binary inputs (N0 the least significant and N3 the most significant).
- to perform a measurement the input MES_DCH must be set to a logic high and remain so during the measurement. **Input states are valid only on the rising edge of MES_DCH.**

The unit will do a measurement or give an error if parameters are incorrect. The CTRLOUT will be a logic high at the first measurement and remain so until a logic low is set on CTRLIN. During the measurement the instrument will send different signals according to test results and selected parameters. These can be an error signal (ERROR), end of test (EOT), or a signal showing test results (PASS or FAIL). This signal is activated as a logic high. To force the instrument to discharge the programmable controller must set a logic low on MES_DCH, then reset CTRLOUT by resetting CTRLIN and set the MES_DCH.

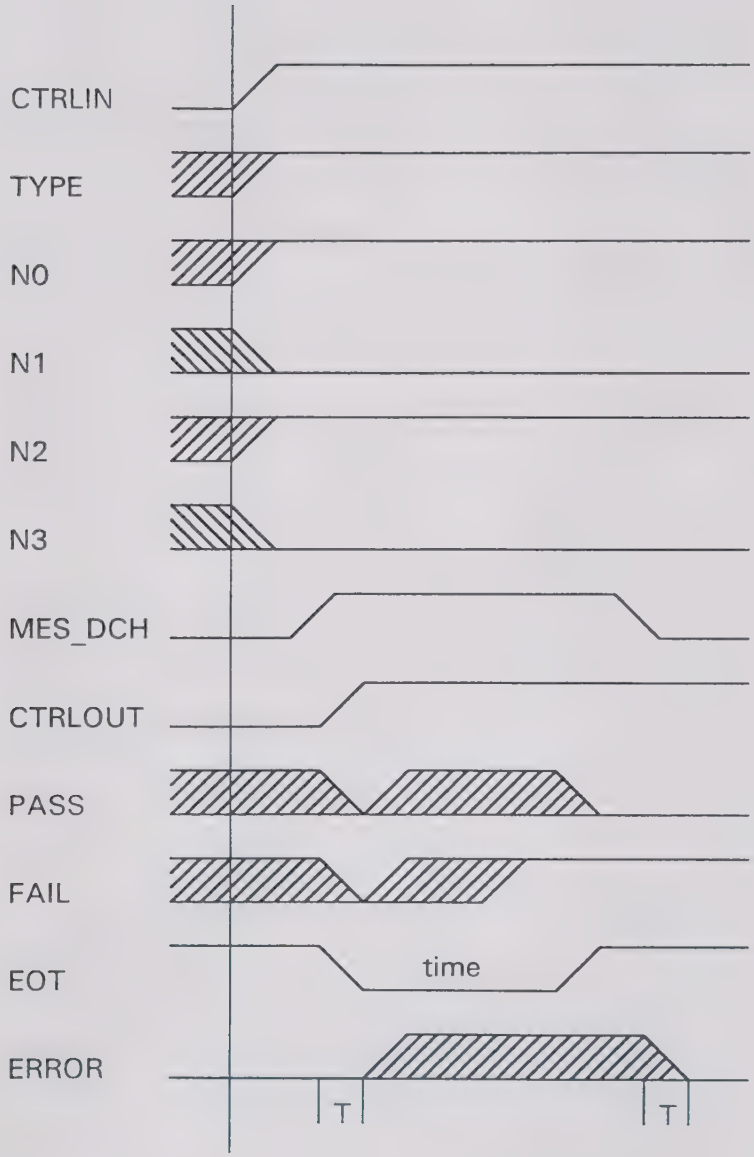


Figure 5-1
Megohmmeter Function, Memory 5, Test Failed

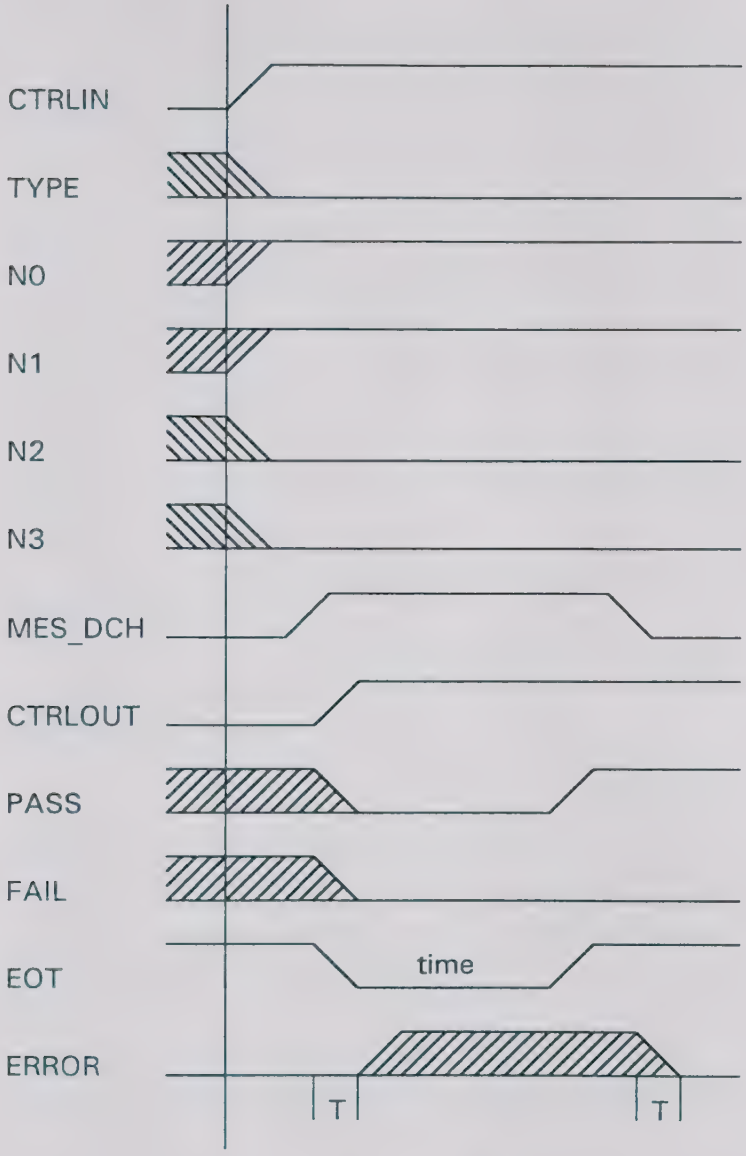


Figure 5-2
Hipot Function, Memory 3, Test Passed

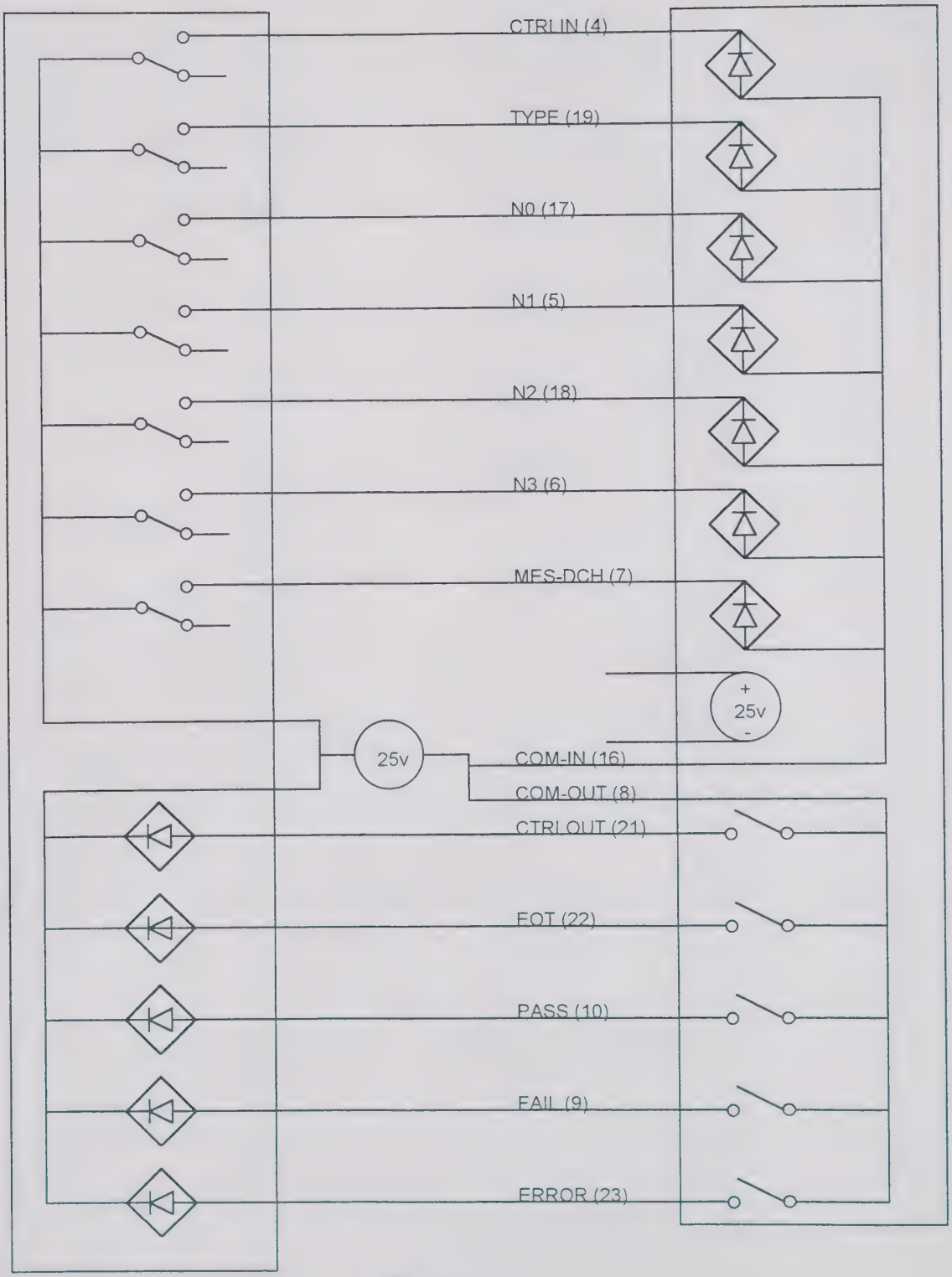


Figure 5-3
I/O Interface Connection With External Supply

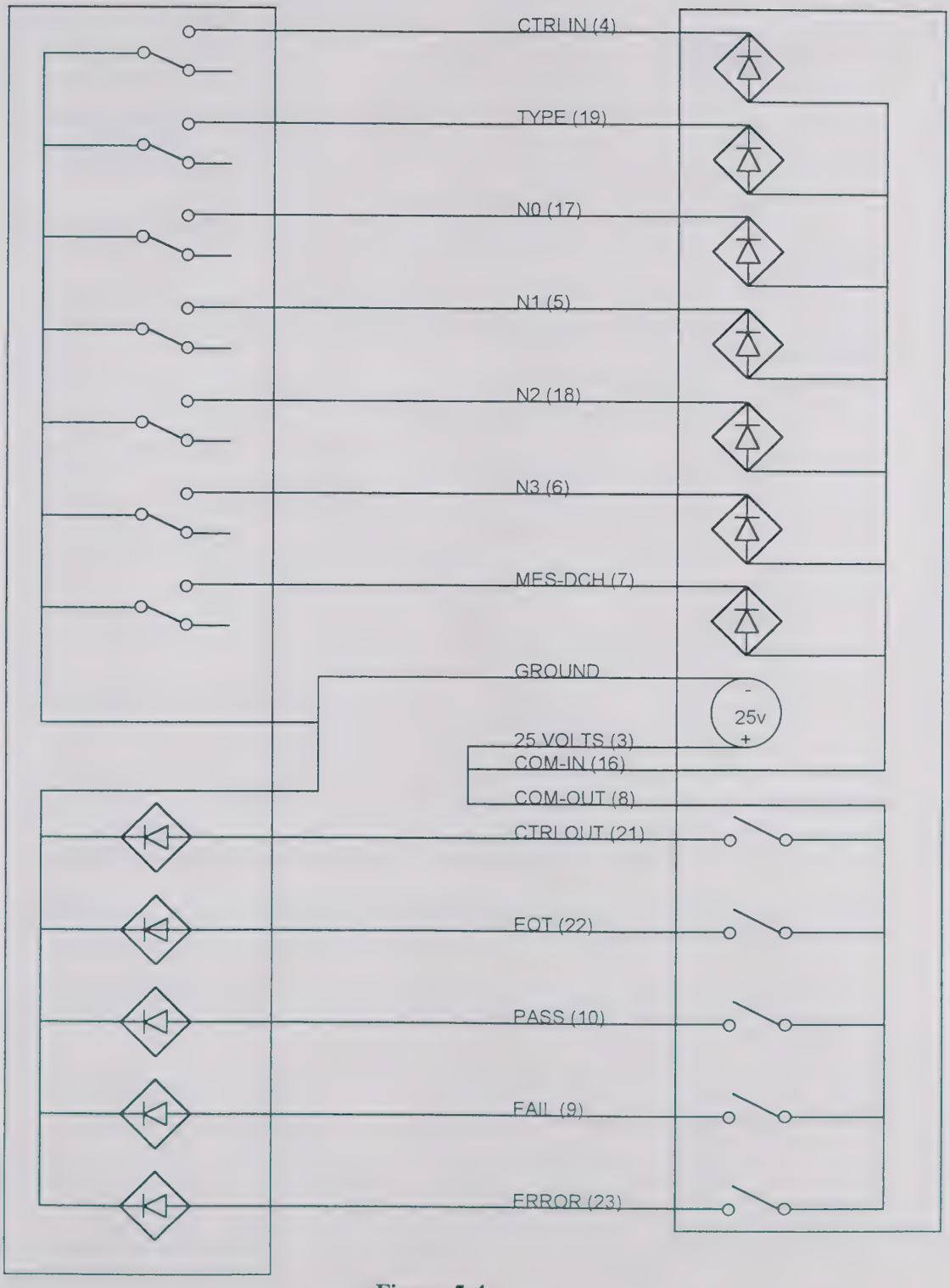


Figure 5-4
I/O Interface Connection With Internal Supply

5.1.4 0/10 Volt Input/Output

The 0 - 10 V Input/Output option allows the instrument to deliver a analog voltage proportional to the measurements shown on the display (insulation resistance, test voltage, leakage currents) and allows control of the hipot test voltage. Jumpers on this optional board allows variations in the selection of features.

Specifications

Output voltage:	from 0 to 10 VDC by 2.44 mV steps
Output Accuracy:	+/-(0.1% + 5 mV)
Output impedance:	1 kohm +/-5%
Reference:	chassis ground
Connection:	I/O Interface (25 pin), Table 5-1
	Pin 11 - 0 to 10 VDC output as defined below
	Pin 12 - ground
	Pin 24 - 0 to 10 VDC output as defined below
	Use shielded cable output, with shield connected to pin 12

Operation

To enable operation of the 0 to 10 V feature:

- Go to Setup Display (paragraph 2.3.2)
- Select <PAGE: 2>
- On the INTERFACE line select PLC (If the 0 - 10 V Input/Output option is not present the message MISSING OPTION will be displayed).

Input/Output Function in Megohmmeter Mode

Voltage V1(pin 24) = value in range, 0 to 10 V compared to the displayed value

Voltage V2 (pin 11) = value of the range:

00.00 kohm = 0 V
000.0 kohm = 1 V
0.000 Mohm = 2 V
00.00 Mohm = 3 V
000.0 Mohm = 4 V
0.000 Gohm = 5 V
00.00 Gohm = 6 V
000.0 Gohm = 7 V
0.000 Tohm = 8 V

The resistance value is given by the following formula: $R = 2\ (V1)\ (10^{V2})$ kohms

for example; if V1 = 5.2 V and V2 = 3.0 V then R = 10.4 Mohms

Input/Output Function in Hipot Mode

Voltage V1(pin 24) = value of measured voltage, 0 to 10 V for 0 to 5000 VAC
= value of measured voltage, 0 to 10 V for 0 to 6000 VDC

Voltage V2 (pin 11) = value of leakage current, 0 to 10 V for 0.00 mA to 9.99 mA

The test voltages and leakage current given by the following formula:

VAC = (V1/10) x 5000 V
VDC = (V1/10) x 6000 V
I = (V2/10) x 9.99 mA

5.2 RS232 Interface

The Guardian is available with an optional RS232 serial port interface, available through a connector (9 pin) on the rear panel of the instrument, for connecting to a PC. The RS232 standard defines electrical specifications for the transmission of bit serial information. The use of the RS232 port requires three lines, receive data, transmit data, and signal ground as listed in Table 5-2. Included with this RS232 option is the interconnection cable shown in Figure 5-5, QuadTech part number 630067.

Note: For remote operation the instrument must be returned to its Power-up Display (Paragraph 2.3.1)

Table 5-2
RS232 Interface Connections

Signal Name	Pin Number	Function
	Inputs:	
RXD	2	Receive Data
	Outputs:	
TXD	3	Transmit Data
GND	5	Signal Ground

The commands are the same as listed for the IEEE-488.2, refer to paragraph 5.4.

The communication parameters are fixed as follows:

speed:	9600 baud
parity:	no
format:	8 bits
stop bit:	1

The end of a message must be the **LF** character.
Separators within a message are **;or :**
The maximum number of characters in the message is 100 or 8 different commands.
The end of the execution of a complete message by the unit is indicated by the emission of the **XON** (chr$(17)) character and allows synchronized communication with the computer.

The computer awaits the XON character before sending the next message.
The events occurring during measurement are indicated to the computer by the emission of the **Z** character (format error, end of test, interlock open, ...). When receiving this character, a special command allows the computer to get the event (command *STB?)
If the message is not recognized by the unit the error message **<DIALOG ERROR:1>** is displayed.
If the code is out of context the error message **<DIALOG ERROR:2>** is displayed (special code for a function when the function was not selected or numerical value out of range.

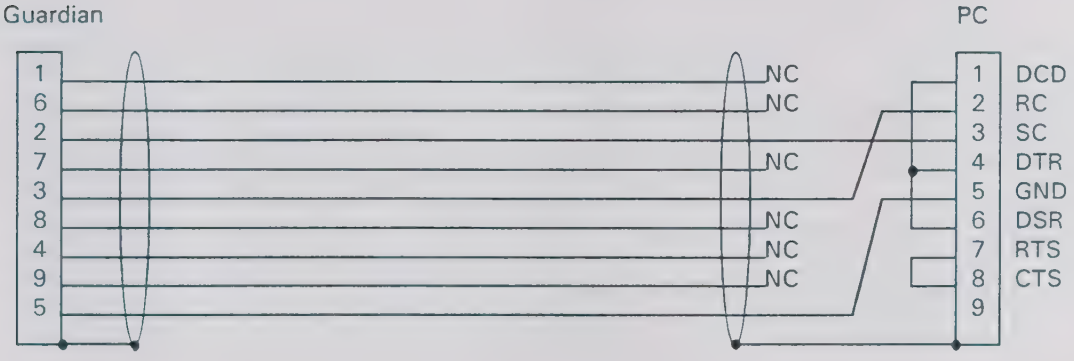


Figure 5-5
RS232 Cable

5.3 IEEE-488.2 Interface

The Guardian comes standard with IEEE-488 interface with connection through a connector (24 pin) on the rear panel. This interface can be used to connect to a system containing a number of instruments and a controller in which each meets IEEE Standard 488.2 (Standard Digital Interface for Programmable Instrumentation) Refer to paragraph 5.4 for the command set.

Note: For remote operation the instrument must be returned to its Power-up Display (Paragraph 2.3.1)

5.4 Command Set

Numerical Format:

NR1: +/-<digit>.....<digit>
NR3: +/-<digit>...<digit> . <digit>...<digit> E +/ - <digit> ...<digit>

General Commands:

REM (REMote):	go to remote mode
GTL (GoToLocal):	go back to the local mode
LLO (LLockOut):	go back to the local mode is locked

Common Commands:

*SRE <NR1>: "Service Request Enable Register"
Enables the corresponding summary messages (bits) in the status byte register. Thus, the application programmer can select reasons for the device to issue a service request. (Z character). See *STB? code.

*ESE <NR1>: "Standard Event Enable Status"
Select which event bits in the corresponding Event register will cause a TRUE summary message when set. By use of the enable bits the programmer can program the device to request for a single event or an inclusive OR of any group of events.

*CLS: Sets all the standard registers in the state the programmer found them after a power on.

*RST: The Clear status command resets as a power on.

Common Queries:

*STB?: return in hexadecimal format a <NR1> which is the value of "STB". (i.e: "#H80")

b0: 0 = interlock opened
1 = interlock closed

b1: 0 = no error
1 = error (voltage not correct, ...)

b2: 0 = end of test
1 = test running

b3: 0 = test failed
1 = test pass

b4: not used

b5: logical OR of the ESR register bits

b6: logical OR of the STB register bits

b7: not used

*SRE?: return in hexadecimal format a <NR1> which is the value of "SRE". (STB register mask)

*ESR?: return in hexadecimal format a <NR1> which is the value of "ESR".

b0 to b3: not used

b4: 1 = dialog error type 2 (numerical value out of range, out of context command)

b5: 1 = dialog error type 1 (incorrect command)

b6: not used

b7: 1 = power on

Note: the bits are reset after the reading of the byte by the *ESR? command

*ESE?: return in hexadecimal format a <NR1> which is the value of "ESE". (ESR register mask)

*LRN?: This device query allows the programmer to receive a response message unit that informs the programmer on the current device state (test mode and current test parameters) and may be later used as program message unit elements to place the device in the state it was.

*IDN?: allows the identification of the unit. The message is a follows:
<field1>,<field2>,<field3>,<field4>
field1: manufacturer name = QuadTech
field2: unit reference = Guardian
field3: serial number = 0 (not used)
field4: software version = VERSION 1.50

Note: the command must be used before selecting a function (from the start display)

*TST?: allows a check that the unit is working correctly. The message is as follows: #H<NR1> with :
NR1 = 0 : if all the boards have been recognized
NR1 = 1 : if the megohmmeter is not recognized
NR1 = 2 : if the hipot board is not recognized
NR1 = 3 : if no board is recognized

Note: this command must be used before selecting a function (from the start display)

Device Commands:

MEG (MEGohmmeter):
Select the megohmmeter (must be sent form the Power Up display).

HIP (HIPot):
Select the hipot tester (must be sent from the Power Up display).

CONF (CONFig):
Select the configuration function of the unit (must be sent from the Power Up display).

PAR (PARameter) <NR1>:
Select the parameter set for the function active, i.e: MEG:PAR 1

DCV (DCVoltage) <NR1>:
Set a new value in volts to the current DC voltage parameter to the parameter set of the active function, i.e: DCV 500

ACV (ACVoltage) <NR1>:
Set a new value in volts to the current AC voltage parameter to the parameter set of the active function, i.e: ACV 5000

HTIM (HTIMe) <NR1>:
Set a new value in seconds to the current hold time parameter to the parameter set of the active function, i.e: HTIM 3

RTIM (RTIMe) <NR1>:

Set a new value in seconds to the current rise time parameter to the parameter set of the active function, i.e: RTIM 10

FTIM (FTIMe) <NR1>:

Set a new value in seconds to the current fall time parameter to the parameter set of the active function, i.e: FTIM 5

HLIM (HLIMit) <NR3>:

Set a new value to the high limit parameter to the parameter set of the active function, i.e: MEG:HLIM 2.0E+6 (in ohms)
RIG:HLIM 1.45E-4 (in amps)
The units is automatically given in volt, ohm, or amp and function dependent.

LLIM (LLIMit) <NR3>:

Set a new value to the low limit parameter to the parameter set of the function active, i.e: MEG:LLIM 1.0E+6 (in ohms)
RIG:LLIM 3.50E-6 (in amps)
The units is automatically given in volt, ohm, or amp and function dependent.

DISP (DISPlay) ON/OFF:

This command is attached to the configuration function and controls the display mode, i.e: CONF:DISP OFF

TIM (TIMe) AUT:

Hipot function: select only the automatic mode.

FILT (FILTer) NOR/CAP:

Enables the normal or the capacitor measurement modes, i.e: CONF:FILT CAP

DET (DETection) OFF / I / I + DELTA / DELTA:

Hipot function only: set mode of the breakdown detection.

MEAS (MEASure) :

Run the current function.

STOP :

Stop the current function.

QUIT:

Exit the current function.

Queries:

MEAS?:

Return the current measurement value(s) regarding the function's running. Depending on the function get:

OHM 4.700E+06

or:

VOLT 498 AMP 1.045E-3

General Examples:

1) configuration actions:

REM	(go to remote mode)
CONF	
FILT CAP	(capacitor measurement mode selection)
DISP ON	(measurement result display with no change)

2) testing in megohmmeter mode:

REM	(go to remote mode)
MEG:PAR 5	(megohmmeter function with parameter set number 5 request)
DCV 250	(new voltage test)
HLIMIT 3.45E+9:LLIM 1.26E+6	(new upper and lower limits)
HTIM 10	(new hold time)
MEAS	(start the test)
.....	
.....	
MEAS?	(request the measure value)
.....	
.....	
STOP	(stop the test)
QUIT	(return to the main state which allows selection of any other function)

2) testing in hipot mode:

```
REM          (go to remote mode)
HIP:PAR 5    (hipot function with parameter set number 5 request)
TIME AUT     (mode automatic)
ACV 1550     (new ac voltage test)
HLIMIT 10.0E-3:LLIM 1.5E-3 (new upper and lower limits)
RTIM 3:HTIM 5:FTIM 2:   (new test times)
DET I+DELTA  (new detection mode)
.........
MEAS         (start the test)
.........
.........
MEAS?        (request the measurement values, V and I)
.........
.........
STOP         (stop the test)
QUIT         (return to the main state which allows selection of any other
              function)
```

Section 6 Maintenance & Calibration

6.1 General

Our warranty (at the front of the manual) attests the quality of materials and workmanship in our products. If malfunction should be suspected, or other information be desired applications engineers are available for technical assistance. Application assistance is available in the U.S. by calling 508-485-3500 and asking for Applications Support. For support outside of the United States please contact your local QuadTech distributor.

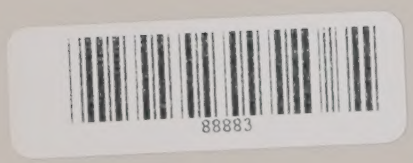
6.2 Instrument Return

Before returning an instrument to QuadTech for service please call our Service Department at 800-253-1230 for return material authorization. It will be necessary to include a Purchase Order Number to insure expedient processing, although units found to be in warranty will be repaired at no-charge. For any questions on repair costs or shipment instructions please contact our Service Department at the above number. To safeguard an instrument during storage and shipping please use packaging that is adequate to protect it from damage, i.e., equivalent to the original packaging and mark the box "Delicate Electronic Instrument". Return material should be sent freight prepaid, to:

QuadTech, Inc.
100 Nickerson Road
Marlborough, MA 01752

Attention: Service Department

Shipments sent collect can not be accepted.



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